

Handedness Effects on Playing a Reversed or Normal Keyboard

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A group of left-handers, approaching the piano for the first time, showed better performance in playing a reversed keyboard (where the pitch decreased from left to right) than a normal keyboard. By testing a separate group of “experienced” left-handers, it was also found that this observed preference that naive left-handers had for the reversed keyboard can disappear with a few years of practice on a normal keyboard. The initial preference for the reversed keyboard shown by left-handers appeared to be specific for this handedness group, as groups of right-handers, regardless of their level of experience with the piano, performed better with the regular keyboard. Finally, based on these results it was hypothesised that left-handers would encounter considerable frustration in learning the “right-handed” piano. However, an informal demographic study of piano students enrolling at a school of music did not reveal a substantially low prevalence of left-handed pianists.

INTRODUCTION

Music instruments, like most man-made tools, are generally built for the right-hander. In a sense, these are “right-handed” objects. The roles that each hand

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plays when manipulating these objects are not arbitrary or casual, and often appear to be complementary. The clearest example of this is provided by the playing of stringed instruments and the keyboards. With stringed instruments, the left hand positions its fingers in precise locations while the right hand strikes the target strings in exact temporal sequences (often with a single movement of the whole hand, as in bowed instruments). With keyboards, typically (there are certain exceptions), the left hand plays the chords or harmony, while the right moves its fingers at a faster rate to deliver the melody.

Playing an instrument is clearly a bimanual task in which the two hands cooperate simultaneously for the performance of one combined action. Many common or everyday actions fall into the category of simultaneous bimanual cooperation (e.g. opening a bottle/box, peeling a fruit/vegetable, cutting bread/meat, dialling a phone, hammering, beating, etc.). In performing many unimanual tasks (e.g. writing, drawing, grasping, throwing, pointing, hitting, holding without manipulating, etc.), it is the right hand that is generally preferred. Thus, not surprisingly, in bimanual tasks it is also the right hand that is typically preferred for those aspects of the action that require either the greatest force and/or the most rapid sequencing of movement. In many bimanual tasks the left hand plays the "supportive" role, by holding and positioning an object, while the right hand acts upon the object (e.g. holding fruit when peeling or a bottle when opening it and, when playing a stringed instrument, pressing a string while the right hand repeatedly and rapidly strikes it in an orderly sequence). Of course, there are certain exceptions among all bimanual tasks, such as expert typing. However, in this latter case the keyboard layout itself (i.e. the QWERTY) was apparently designed to reduce the speed of typing (in order to reduce the occurrences of key jamming—a serious problem with early mechanical machines) by equalising the speed of the two hands. This was accomplished in 1874 by QWERTY's inventor, Christopher Sholes, with the assignment of some of the most frequent letters—E, T, and A—to the "slower" left hand instead of the "faster" right. As a result, one could say that the type-keyboard has survived in the form of a left-handed tool in a mostly right-handed world (see Diamond, 1997).

Left-handers often mirror right-handers in unimanual tasks. However, for some unimanual tasks there are clear limits (and dangers) to the liberty left-handers can take in using their preferred hand (Coren, 1993). These constraints are mainly external. There are social conventions (e.g. shaking hands; holding fork and knife at a formal dinner) or constraints imposed by the shape of tools and the position of their operating parts (e.g. power tools, can-openers, pouring lips of kitchen containers, door knobs, telephones, computer keyboards plus mouse). Nevertheless, left-handers can still clearly mirror the right-handers in many of these externally limited actions. For example, in the domain of sports, the elements of surprise in an unusual mirroring movement can actually be quite advantageous.

Just as left-handers mirror right-handers in unimanual tasks, it would seem natural to expect that the left-handers also mirror right-handers in bimanual tasks. In fact, the mirroring of hand-use by left-handers is observed for many bimanual tasks (e.g. peeling), and it is often demonstrated in the playing of musical instruments. It is not unusual, especially in popular music (where there is the least stress on "social conventions", tradition, or schooling), to see guitarists playing their instrument with reversed hands, after rotating the standard (right-handed) instrument through circa 180° (e.g. Jimi Hendrix, Paul McCartney). This strategy applies in principle to all stringed instruments, where the order of the strings can easily be switched around and, with some other physical modifications to the instrument, can be played in reverse (as Charlie Chaplin did with his violin). Wind and brass instruments can also be played with reversed hands, although this changes the fingering. Apparently, "left-handed conductors" are not uncommon (Oldfield, 1969), in the sense that they choose to beat the tempo in mirror fashion (often to the confusion of the instrumentalists who are more used to "normal" right-handed conducting patterns). But, of course, conductors only hold an instrument in their hands figuratively and their movements may thus be released from physical constraints.

The truly, inescapably right-handed instrument is the keyboard or (to use a metonym from now on) the piano. The piano, more than any other instrument, allows the musician to play melody and harmony at the same time; thus allowing one to tease apart the tight temporal relationship between the sequence of movements of the two hands (typical of monophonic instruments). As we mentioned earlier, the melody, although played simultaneously with the harmony, typically moves faster in time than the harmony or progression of chords. Interestingly, one hand always follows a rhythm that is a synchronised subdivision of the other hand's rhythm; a characteristic that points to the impossibility of humans generating multiple independent, unsynchronised, parallel action plans for the two hands. Although a rubato can be performed on the piano (i.e. a departure by one hand from the common time base), this is likely to be accomplished by rapid time-sharing of a single attentional/intentional mechanism between the two hands. This is exemplified by the fact that even expert musicians clearly show interference effects between the hands when performing "rubato-like" tasks (Peters, 1985). The reason for this constraint in motor planning likely derives from the need to have a single source for the bilateral control of actions. Generating multiple and conflicting plans of actions would be inadapative for either navigational and manipulation purposes; consequently, parallel mechanisms of attention and control of same, or closely related, effectors, may be suppressed by evolutionary pressure. The cerebral unilateral control of speech and handedness appears to reflect this constraint on the brain's bilateral motor control, as several authors have pointed out (e.g. Corballis, 1991; Kosslyn, 1987).

Michael Peters (1986, 1991, 1992, 1994), in particular, has framed the problem of simultaneous bilateral control as a problem of attentional demands. In this account, the melody (i.e. the fast component of the musical performance) is viewed as the "figure" while the harmony is the "background". Focal attention can be directed only to one hand at a time and therefore right-handers tend to focus their attention on the right hand. For example, in finger-tapping tasks, when the execution of a fast temporal figure is assigned to the right-handers' preferred hand while the left does the slower temporal background (Peters, 1981, 1985), performance is better than in the reversed condition. Additionally, the left hand may in general receive less optimal input commands than the right from the left hemisphere's control areas. Such left-handed disadvantage is hypothesised to occur mainly because: (1) the unilateral specialisation of a "generative mechanism" for action (Corballis, 1991) is typically on the left side for right-handers; (2) in primates, the motor areas control the contralateral arm, hand, and finger (ipsilateral control being possible only for axial and proximal forelimb muscles; Brinkman & Kuypers, 1972), whereas an estimated 85% of proprioceptive feedback is received by each hemisphere from the contralateral limb (Ruch, 1965); and (3) input/output between opposite lateralised systems degrades across the long transmission fibres of the corpus callosum (Kosslyn & Koenig, 1995; Rizzolatti, Umiltà & Berlucchi, 1971; Van Kleeck & Kosslyn, 1991) (cf. Desimone, Fleming & Gross, 1980; Gross, Rocha-Miranda & Bender, 1972; Schwartz, Desimone, Albright & Gross, 1984; Stucchi & Viviani, 1993). Finally, Peters and Servos (1989) have also proposed that right-handers and left-handers may differ fundamentally in the way they distribute attention to their hands when they concentrate on a difficult bimanual coordination task. The right-handers appear to focus their attention on their right hand, whereas the "consistent" left-handers (i.e. individuals who use the left hand for tasks that require precision as well as those requiring strength) appear to focus their attention relatively more to the left hand.

If the preferred hand is faster and more regular in performance than the non-preferred hand (and particularly so in right-handers; Peters, 1981, 1986), it makes sense that the piano would be built according to a right-handed blueprint, with the high pitch keys, which typically carry the melody, on the same side as most musicians' preferred hand. Essentially, it was a majority rule that decided, historically, how the piano's palette of sounds should be arranged.

A question then arises; is this arrangement unfavourable to the left-handers who approach the piano? And if the previous question is answered in the affirmative, a further question would be: can this presumed handicap be overcome, or would it carry so much weight as to affect the actual number of left-handers who can successfully master the instrument? Or would it simply discourage the less musically talented and/or motivated among the left-handers?

To answer these questions we carried out the following investigations. First, we directly put to test the idea that left-handers can indeed find it difficult to

play the “normal” keyboard and, instead, can do much better if the keyboard’s pitch progresses from low to high but from right to left. Groups of right-handers and left-handers were asked to play simple piano pieces on a regular keyboard and one where the mapping of keys to note was reversed (i.e. pitch decreased from left to right). Second, we divided both groups into two subgroups according to whether each subject was “naive” with a keyboard or already “experienced” with it (either having attempted to receive some training or currently playing it). We reasoned that if the regular piano is unfavourable to left-handers, their performance should be better overall with the reversed keyboard. However, if practice overcomes initial “natural” dispositions to a specific orientation of the keyboard, the advantage for the reversed or left-handed keyboard should be presented only for the “naive” left-handed participants, and should disappear or invert with the “experienced” ones.

The answers to the other questions we have posed can only be found by collecting “demographic” evidence about the prevalence of left-handers among professional pianists. To this purpose we also carried out an informal investigation within a well known school of music.

METHOD

Participants

A total of 28 participants, all students at Harvard University, volunteered for this study, which was advertised as an investigation of music performance. These participants were selected for the study in order to constitute four completely balanced groups ($n=7$) of left- and right-handers, either “naive” or “experienced”. The “naive” participants had never practised playing a musical keyboard before this experiment, whereas the “experienced” participants had played or were currently practising the instrument (mean years of practice=2 years, $SD=1$). A prerequisite for all participants in this experiment was that they knew how to read music reasonably well. In the specific case of the “naive” participants, this meant that they either participated actively in choirs as singers or played an instrument other than the keyboard (e.g. flute, violin).

Handedness of the subject was assessed with the Edinburgh Handedness Inventory. Participants who indicated a preference for right hand use on 8 out of the 10 questions were admitted to the right-handed group, and those who indicated the same amount of preference for the left hand were admitted to the left-handed group. A few individuals who did not meet these criteria were not admitted as participants to the study.

Stimuli and Apparatus

An electronic keyboard (Ensoniq TS 10) was used, because it allowed the easy re-mapping of pitch to keys. A switch, controlled by the experimenter at the beginning of each condition (normal/reversed), caused the pitch reversal on this same keyboard. Re-mapping an electronic keyboard solves the “software” problem, but does not get around the “hardware” problem. More specifically, the relative spatial relationships between the black and white keys do not invert. As this may have created interference, particularly for the experienced players, between the visual knowledge of the arrangement of the keys and the way these keys sounded on the new keyboard, we opted for the strategy of inverting the mapping of the white keys only. During the experiment a rigid black cardboard mask covered the black keys. By necessity, the pieces of music that we selected required playing only the white keys.

The electronic keyboard output was delivered to a Power Macintosh computer. The computer used SoundEdit software to record a digital version of the participants’ performance, so that this could be analysed later for accuracy of key presses.

In the reversed keyboard condition, we also vertically “reversed” the score by switching the position of the clefs. In this way, the spatial relationship between the top stave (now playing the bass clef) and the right hand, and the bottom stave and the left hand (now playing the treble clef) remained constant. Three different simple scores were used. These included a melody mainly of quarter notes, all in the treble clef. The accompaniment in the bass clef consisted of single whole notes. The scores are reproduced in Fig. 1.

Procedure

Participants sat comfortably in front of the keyboard and were given a head-set from which they could hear what they played. The sound of the keyboard was set to the timbre of a grand-piano. Before starting a condition, the experimenter (AP) demonstrated the middle position on the keyboard of the scale to be used. The C3 was marked with a yellow sticker to show its position, and this label was moved to its appropriate location for the normal and reversed keyboard conditions. Participants were requested to play as accurately as possible, both in terms of key presses and tempo. They were also instructed that in the event of an error, they should continue to play the piece without re-starting or attempting to correct themselves. No time constraints (e.g. use of a metronome) were given to the participants. We stressed that the emphasis was on accuracy and not speed of execution. However, participants were encouraged to respect the time relations between notes, as indicated in the score. Every subject performed each piece first on the normal keyboard and then on the reversed version, and each piece in the order indicated by its numbering.

Melody 1



Melody 2



Melody 3



FIG. 1. The three simple scores.

RESULTS

Note Accuracy

Errors in key presses (i.e. wrong note selections) were counted for each melody and converted to a percentage score. A repeated-measures analysis of variance was performed, with Handedness (left/right) and Experience ("naive"/"experienced") as the between-participants factors, and Keyboard (normal/reversed) and Melody (1/2/3) as the within-participant factors.

The analysis revealed two statistically reliable effects. One was the main effect of melody; $F(2, 48) = 4.1$, $P < .02$. Fewer errors were committed on the first piece (mean % error = 8.5, SD = 18) than the following two (melody #2: mean % error = 18, SD = 22; melody #3: mean % error = 11.5, SD = 21). This effect likely reflects the level of difficulty of the pieces, rather than fatigue. Most importantly the three-way interaction of keyboard $\times$ handedness $\times$ experience was significant; $F(1, 24) = 5.5$, $P < .02$. Figure 2 illustrates the observed interactive effects. The "naive" left-handers made fewer errors with the reversed keyboard (mean % error = 11.1; SE = 4.8) than the normal keyboard (mean % error = 23.3; SE = 6.0) whereas the "experienced" left-handers showed the opposite pattern of performance and made fewer errors with the normal keyboard (mean % error = 9.9; SE = 3.2) than the reversed one (mean % error = 21.6; SE = 5.2). A separate ANOVA on the mean % error rate of the "naive" left-handers only, with Keyboard (normal/reversed) as the within-participant factor, showed that this difference was statistically reliable; $F(1, 6) = 7.9$; $P < .05$. Right-handers showed a very different pattern of performance, with both the experienced and naive participants performing better with the normal keyboard (experienced: mean % error = 2.1; SE = 1.0; naive: mean % error = 4.6; SE = 2.5) than with the reversed keyboard (experienced: mean % error = 9.7; SE = 6.0; naive: mean % error = 21.3; SE = 6.2).

Inter-note Variability

A separate analysis was performed on a measure of variability of participants' performance. To this purpose, we calculated the time (in milliseconds) between each note and computed the standard deviations of each individual for each of the three pieces in the two keyboard conditions. These data were entered in a repeated-measures analysis of variance with Handedness (left/right) and Experience ("naive"/"experienced") as the between-participants factors, and Keyboard (normal/reversed) and Melody (1/2/3) as the within-participant factors. We reasoned that differences in inter-note variability between groups would reflect differences of performance due to hesitations and lack of precision in the timing of the key presses. Indeed, if the melody is assigned to the non-preferred hand, and if we assume that the motor commands to the non-preferred

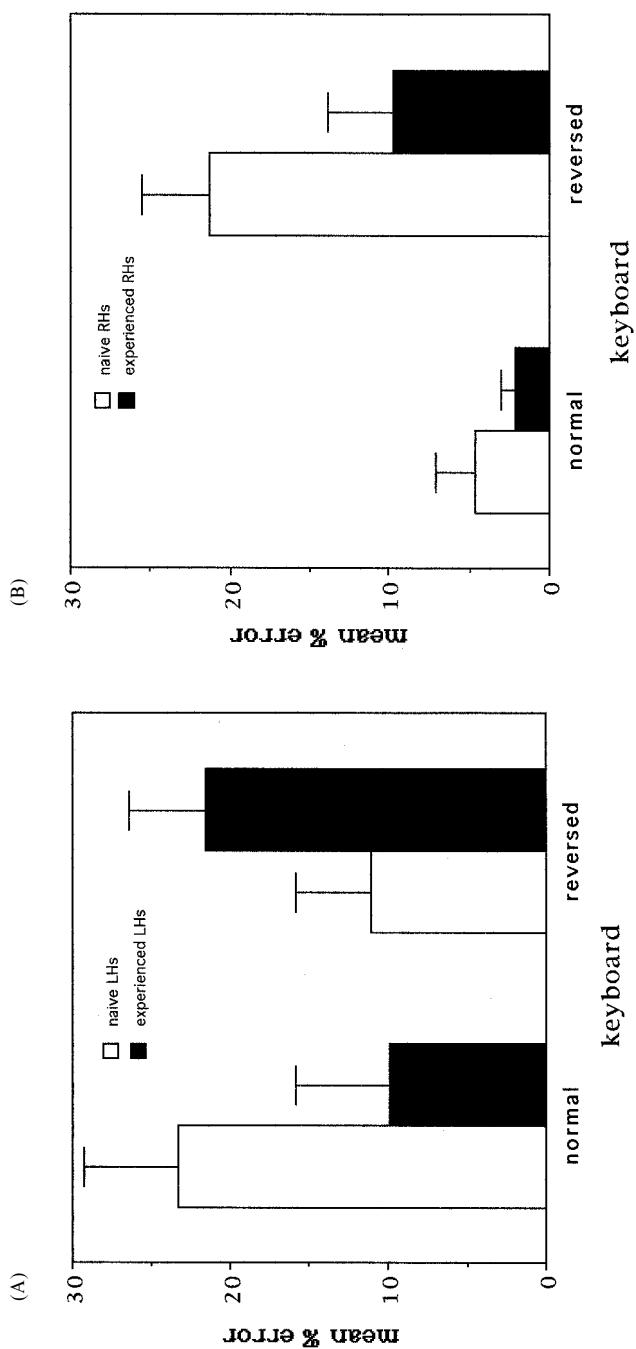


FIG. 2. Mean percentages of errors for (A) left-handers and (B) right-handers.

hand are generally more variable than those to the preferred hand (cf. Annett, Annett, Hudson, & Turner, 1979), then we should expect an increase in variability of key presses.

The analysis revealed only two statistically reliable effects. One was due to the main effect of melody; $F(2,48) = 14.7$, $P < .0001$. Post-hoc tests revealed that there was more variability in the performance of the second piece (mean $SD = 4939\text{ms}$) than the other two (melody #1: mean $SD = 3128\text{ms}$; melody #3: mean $SD = 3628\text{ms}$). This result is consistent with the highest error rate of the second piece described in the previous section.

The other reliable effect was that overall there was more variability in performance with the reversed than the normal keyboard; $F(1,24) = 6.7$, $P < .01$. Indeed, from the findings described in the previous section, we would expect that the reversed keyboard should create difficulty for all groups except the naive left-handers. However, the interaction of experience with handedness and keyboard failed to achieve significance in this analysis. Possibly, this effect may be revealed with larger groups of participants.

Discussion

The experiment revealed that left-handers who do not have previous experience with a piano do show an advantage in performing musical pieces when the fast-moving portion of the score (melody) is played by their preferred left hand, while the slow-moving musical background (harmony) is played with the right hand. With practice, experienced left-handers appeared to substitute this advantage of the reversed keyboard with one for the normal keyboard, and in fact they greatly resembled the experienced right-handers in their performance in this latter condition. As the naive right-handers also showed a better performance with the normal keyboard (i.e. when the melody was played by the right hand), we may generally conclude that inexperienced participants of either handedness find it more comfortable to perform the melody with their preferred hand. This is substantiated by comments made by naive left-handed participants who stated that the reversed keyboard “made more sense” and was “less confusing”.

These results suggest that, at least in some musical tasks, inexperienced left-handed participants may find it difficult to assume the hand roles that the structure of the piano imposes on the player. However, it is likely that with musical pieces in which the harmony occurs at an equal or higher speed than the melody, naive left-handed participants are able to display their best performance with the normal keyboard. The key issue, then, is how common is it, in the “real world”, for piano beginners to approach pieces with complex parts for the left hand as opposed to the ones we used in the experiment. Our belief is that only advanced piano students (that is, at a stage in which practice may have already eliminated the initial differences between hand performance) approach pieces in

which the role of the left hand is more or equally complex than that of the right hand. This last observation appears even more true if we consider the temporal demands of the hand's action to be of most relevance. Playing a sequence of chords (i.e. the typical role of the left hand) would seem to pose different kinds of demands, more spatial (i.e. the simultaneous positioning of multiple fingers) and less dynamic in nature.

Indeed, a full explanation of why the hands assume the roles they do in music performance probably lies in considering the complementary roles of the two hands. The left hand, which is under more direct neural control of the right hemisphere than the left, may benefit from this hemisphere's better representation of the coordinates of spatial locations (Kosslyn, 1987; Laeng, 1994), and this relationship between hand and cerebral hemisphere may be particularly true for the right-handers (see Laeng & Peters, 1995). If this reasoning is correct, we would have two reasons for the observed complementary role of the left hand, instead of interpreting it simply as a default choice or the reflection of a primary advantage of the right hand/left hemisphere in generating rapid sequences of movement. In other words, we speculate that the left hand may be more apt for positioning fingers to precise and subtle spatial locations, whereas the right hand may be more apt for the rapid sequential control of the fingers (with less stress on monitoring simultaneously the detailed spatial information of multiple fingers, either because single notes/positions are selected in series, as often can be the case in playing a melody on the piano, or because the actual location of the action is less constrained, such as where on the string to apply the bowing or the picking).

In conclusion, the suspicion that the "normal" right-handed keyboard may well be an inept tool to place under the hands of the left-handers was supported. Therefore, the conclusion that some or many left-handed beginners may find approaching the piano frustrating does not seem entirely unwarranted; although it also seems that with practice left-handers may overcome these initial difficulties. Thus, one question that can be derived from this hypothesis is the following: are there fewer left-handed players among professional piano players? Or, alternatively: are there more left-handed players among musicians who don't play the piano (e.g. violinists)? In the next section, we present an attempt to provide a preliminary answer to the first of these questions.

PREVALENCE OF LEFT-HANDEDNESS IN PIANO PLAYERS IN A MUSIC SCHOOL

There have been some "demographic" studies that examined handedness among professional musicians. For instance, Oldfield (1969), using the Edinburgh Handedness Inventory (which he actually developed), measured the prevalence of left-handers in a group of 129 professional musicians from two university schools of music in Great Britain. He did not find any unusually low

prevalence of left-handedness in this group. Oldfield concluded that no great or widespread difficulty was experienced in reversing the dominant and non-dominant hands in musical execution as, if this were the case, we would have expected to see a lower prevalence of left-handers among musicians.

More recently, Aggleton, Kentridge, and Good (1994) have collected responses to the same handedness questionnaire from 1 538 participants from different British orchestras. These authors report an increased prevalence of orchestral musicians using their left hand for writing (male musicians = 12.5%; female musicians = 12.6%) when comparing their frequencies to those of the general population data of Davis and Annett (1994). However, it should be noted that compared to other normative data collected by Gilbert and Wisocki (1992), Aggleton et al.'s figures would not show any difference between musicians and controls. Interestingly, however, when musicians were subdivided according to their instrument, there were relatively fewer left-handers among the string players than among the brass and woodwind players, i.e. instruments that require bimanual coordination versus mouth (blowing) to hand coordination.

None of these studies investigated the handedness of pianists; which to us seems to be the instrument that would be more likely to cause difficulty for the left-handed beginner. Therefore, we asked 145 students, at the time of their enrolment in the piano department at the Berklee School of Music (Boston), about their handedness. No questionnaire was given in this case, but instead a simple self-report based on each individual's knowledge of their own handedness was used. Of the 145 students, 16 (11%) indicated that they were left-handed, a prevalence not significantly different from that observed in the general US population for individuals of this generation (Gilbert & Wisocki, 1992).

GENERAL DISCUSSION

Left-handers know very well what frustrations and even dangers there are in living in a world essentially built for the use of the great majority, the right-handers. Perhaps shaking hands with the right hand does not represent a major frustration for the left-hander, but certainly frustrations arise in the use of many tools, which are built to be held in a palm that faces the opposite way. Indeed, Peters (1996) in a survey of 600 left-handers, found many instances of complaints by left-handers about right-handed tools, such as portable circular saws. When handling tools that are meant for the right-handed majority, we should not expect the left-handers to be able to do as well as the right-handers, and in fact much of the clumsiness or lack of "dexterity" that has been notoriously attributed to the left-handers may not at all reflect an intrinsic deficit in motor control, but the effects of the extrinsic shapes of the objects in common use. Indeed, many left-handers excel in sports, where in some cases the element of surprise can actually act in their favour (e.g. in fencing, tennis, and baseball).

Our study essentially attempted to investigate two related questions: is it true that the piano is a "right-handed" object that imposes the same kind of difficulty that other common objects do to the left-hander? Is it also possible that this difficulty left-handers may encounter in piano playing would also cause a reduction in the number of professional musicians who are left handed?

If these hypotheses are valid, we may also expect other far-reaching effects: could there also be relatively few left-handed composers, because (at least in much Western music) training in composition is so based on learning to play the piano fairly well (as a surrogate of the orchestra)?

History tells us that there are famous left-handed pianists in popular music, jazz, or the classical tradition (e.g. Cole Porter, Glenn Gould); nevertheless, these could be isolated cases of extreme talent or passion that succeeds against all odds. Incidentally, there are also accounts of virtuoso pianists who, after losing their right hand, continued their concert career by building a repertoire of left-handed concertos. Paul Wittgenstein, a well established pianist who lost his right arm in World War I, continued to perform in public by commissioning concertos for the left hand from a wide range of composers, among them Britten, Korngold, Prokofiev, Ravel, and R. Strauss. In 1957, Wittgenstein wrote a book entitled *School for the Left Hand*.

Our study provides some preliminary and suggestive answers to the basic questions described earlier. Indeed, the left-handers who approached the piano for the first time found the reversed keyboard somewhat more "natural" to play. We also found that this preference, as reflected by error rate, disappeared when we observed the performance of left-handers with a few years of practice on the instrument. In conclusion, as we expected, the preference for the reversed keyboard was specific to the group of naive left-handers; the right-handers, regardless of their level of experience with the piano, performed better with the regular keyboard.

The plasticity showed by the left-handed participants is remarkable. If fine motor movements do require a single unilateral generator of action (cf. Corballis, 1991), then these findings may imply considerable plasticity (at least in left-handers) in the hemispheric control of hand movements. Alternatively, left-handers may have greater bilateral hemispheric control of fine motor movements than right-handers. In this case, switching the focus of attention from the originally dominant to the non-dominant hand may be easier to accomplish for left- than right-handers.

The idea that there may exist wide plasticity in motor control (directly dependent on the extent of musical practice) is confirmed by a study of Jäncke, Schlaug, and Steinmetz (1997). Right-handed musicians (and particularly pianists, as opposed to string players) showed superior left-handed control (in a finger-tapping measure) compared to right-handed non-musicians. Moreover, the left hand appeared more skilled the earlier in life these musicians had started to practise on the instrument. Such behavioural plasticity may even be mirrored

by neuroanatomical plasticity, because a related study (Amunts et al., 1997) shows that the motor cortex area (in the right hemisphere), which presumably represents the non-dominant left hand, is larger in right-handed musicians than in non-musician controls.

Finally, our demographic study of students enrolling for one semester at the Berklee School of Music did not reveal a significantly lowered prevalence of left-handed pianists. This may imply either that (1) left-handedness does not affect the upper part of the distribution of those who approach the piano or, in other words, the most musically talented and motivated, as perhaps it does for the more "amateurish" part of the distribution; or (2) the sample we used was biased, in the sense that this particular school emphasises jazz music, and therefore the importance of the fast moving and temporally complex left-handed movements in this type of music (e.g. stride). Thus, it may attract more left-handed pianists than would, for instance, a piano school in the classical tradition.

Finally, in future studies, more attention should be paid to different sub-types of left-handers. If, as Peters and Servos (1989) observed, only the consistent left-handers have a bias towards the left in bimanual tasks (whereas the inconsistent ones, or mixed-handers, show the same bias towards the right as the right-handers), then it is more likely that this specific sub-group of left-handers may be the least represented among students of the piano.

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