KINESIOLOGICAL PREFERENCES FOR PAIRS OF LISTING-DEPENDENT MANIPULATIVE SETUPS AMONG MANUAL THERAPY STUDENTS

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ABSTRACT

Introduction: Although there is abundant literature that individuals express kinesiological preferences (KP) related to their handedness and other inborn and acquired factors, apparently this has not been considered in the training or practice of manual therapists. There is no evidence that spinopelvic manipulative procedures primarily based on typical static listings result in enhanced educational or clinical outcomes.

Methods: Participants were asked to perform 8 pairs of equivalent manipulative setups, differing in side of stance and/or tasks assigned to the left and right hands. They expressed which setup they preferred, as well as their degree of preference. Each pair of setups was analyzed descriptively by reporting percentage KP, and inferentially by calculating whether the KP lay outside the 95% confidence interval wherein it could not be distinguished from chance at the p=0.05 level.

Results: In a study where the COVID-19 pandemic limited enrollment and delayed research, a convenience sample of 35 subjects was recruited. Five of 8 KPs were statistically significant; 2 KPs showed an obvious inclination but were statistically insignificant. Only 1 of 8 setups clearly demonstrated no KP. Degree of preference did not impact the results.

Discussion and Conclusion: Given the obvious role handedness plays in sports, art, and other manual skills, ignoring KPs may impact the learning of and eventual delivery of manual therapy skills, with possible negative impact on patient safety and outcomes. Given evidence in both medical and dental settings that requiring left-handed individuals to use equipment designed for right-handed individuals has negative consequences, chiropractic colleges and clinicians might best calculate the risk/benefit profile of ignoring KPs, , whether related to handedness or not, in relation to educational and/or clinical outcomes. Manual therapy institutions might be well-advised to refrain from insisting on the performance of adjustive skills in purely traditional opinion-based ways when more effective alternative strategies may exist. *(J Contemporary Chiropr 2021;4:118-127)*

Key Indexing Terms: Chiropractic; Palpation; Training and Education

INTRODUCTION

A chiropractic manipulative procedure has both a static component, commonly described as a "setup," and a dynamic component that has to do with force delivery. Although there has been considerable research on the dynamic components of the manipulative thrust, such as measurements of force and acceleration (force-time profiles), little is known about whether the traditional elements of a chiropractic manipulative setup are conducive to either student training or optimal clinical outcomes.

Methods for delivering chiropractic manipulative thrusts have been characterized according to their basic elements: doctor's stance, patient position, doctor's contact point, segmental contact point, tissue pull, torque, and line of drive/correction. Although the schema has shown remarkable staying power, there may be value in exploring some of its assumptions (1). It bears the imprint of biomechanical assumptions that require reinterpretation in the light of new knowledge.

For example:

- A vertebra does not travel in the direction of the line of drive that is applied, it moves in a perpendicular direction, so that oblique lines of drive reduce the effective amount of force applied. (2-3)
- Non-perpendicular segmental contacts result in slippage from the intended segmental contact by 2cm or more, which may compound the loss

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of specificity that may be associated with "tissue pull." (2)

- The concept of "torque" - that a bone can be caused to rotate via torque applied to the overlying skin - is illegitimate. (2)
- It may be difficult to consistently maintain the intended spinal or pelvic contacts in delivering a manipulative thrust. (4-8)

We are unaware of evidence as to the extent to which these research findings have impacted the training of chiropractic students, or whether doing so would impact the competence of trainees and/or practicing doctors as well as clinical outcomes.

In addition to the questions raised by these research findings, we would like to draw attention to yet another issue pertaining to psychomotor training in manual therapy that has received little discussion and yet which could potentially exert an important impact on the training and delivery of spinal manipulative thrusts: the importance of operator kinesiological preferences (KPs). It stands to reason that the ability of manual therapists to perform well would require their skill set to be in part dependent on their KPs, as are the skill sets of athletes, artists, and others involved in manual skills. Just as no one would expect a calligrapher to write equally well using either hand, or a football field goal specialist to kick with equal distance and accuracy using either leg, it is likely that manual therapists exhibit important KPs that should not be ignored or overruled. Given that their preferences might be largely based on handedness (or other inborn or acquired characteristics) it might be counter-productive to train them to use their non-dominant arm to contact the spinal or pelvic segmental target or go against their KPs in some way that impedes developing appropriate force or dexterity, or confidence depending on the particulars of the manual skill.

The seeds of the current study were planted when the first author (RC), who had been teaching chiropractic manipulative procedures at 2 different colleges for over 3 decades, noted that when he asked students to walk over to chiropractic tables to demonstrate their "go-to mid-thoracic prone setup" (without providing a specific listing, neither static nor dynamic), the great majority of them spontaneously walked toward the left side of table, facing cephalad. Hypothetically, it seemed that they preferred a stance enabling them to position their dominant right hands closer to the simulated patient. Left-handed students tended to walk to the right side of the table for the same reason, although not as consistently. Starting with this seminal observation, the first author (RC) speculated that it may be counter-productive to conduct chiropractic education strictly within the bounds of the traditional technique schema, not only because it needed updating as described above, but because it completely ignored what may be called the students' KPs.

Both the dental and medical professions have made efforts to address the negative impact of ignoring KPs in training their students. Although their issues have been largely related to equipment, the implications for chiropractic training will be obvious. In a qualitative study conducted at a dental school, the left-handed students reported clinical difficulties being forced to use right-handed equipment, including guilt from causing patient discomfort during treatment. Most felt being a left-handed operator affected their efficiency and confidence level in their early clinical years. (9) Qualitative research conducted at a medical school came to similar conclusions: left-handed medical students reported an adverse impact related to their handedness on dexterity training, due to the imposed need to use equipment designed for right-handed individuals. (10) In chiropractic and to some extent the other manual therapy professions the "equipment" that produces hardship for all the students, not just for the small minority of lefties, is not hardware but something more analogous to software: the traditional inventory of static listings that dictate opinion-based side of stance and appropriate division of labor between the hands while performing spinopelvic manipulative procedures. Indeed, the hardware-related but something more analogous to software: the traditional inventory of static listings that dictate the opinion-based side of stance and division of labor between the hands while performing spinopelvic manipulative procedures.

The primary objective of the current study was to determine whether chiropractic students, asked to demonstrate pairs of alternative methods for manipulating listing-dependent setups central to the college's curriculum, would exhibit consistent KPs. The secondary objective was to see if the quarter in which the students were enrolled impacted upon KPs. The tertiary objective was to determine to what extent the consistency of KPs were impacted by the strength of the students' KPs.

METHODS

A convenience sample including approximately equal numbers of 5th, 8th, and 11th quarter students in a 13-quarter curriculum was recruited. The inclusion criteria were that each of the students must have had some training in each of the skills they were asked to perform, was willing to serve as a simulated patient for the setups, and provided written consent to participate in the study. The Institutional Review Board of our institution approved the project. To determine handedness, each of the subjects completed a 10-item survey based on the Edinburgh Handedness Inventory (Appendix 1) (11).

Table 1. *Alternative versions of equivalent skills assessed in study*

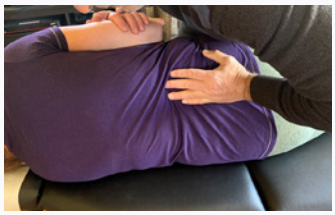
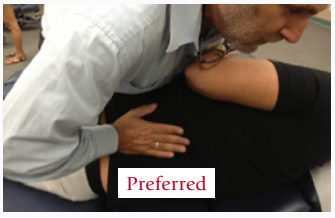
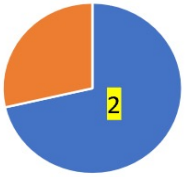
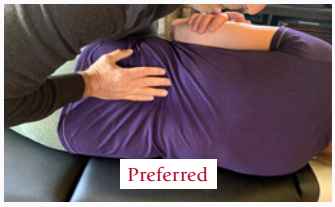
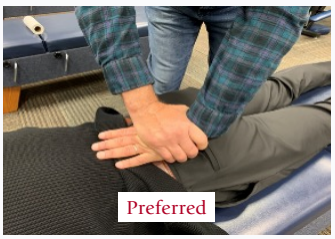
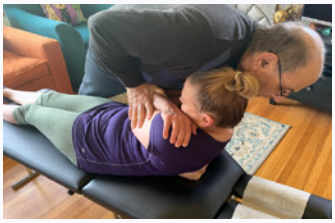
Alternative Versions of Equivalent Skills Assessed in Study				
Skill	**NBCE description**	**Colloquial Description**	**Setup 1**	**Setup 2**
1	Side-posture pisiform/hypothenar - posterior sacral base push	Base posterior	Left side up	Right side up
2	Side-posture pisiform/hypothenar - sacral base contact involved side up or down push	P-R sacrum	Right side up *("involved side up")*	Left side up *("involved side down")*
3	Side-posture pisiform/hypothenar - sacral base contact involved side up or down push	P-L sacrum	Left side up *("involved side up")*	Right side up *("involved side down")*
4	Prone reinforced pisiform/ hypothenar - PSIS contralateral contact push	PI ilium, prone, right	Left stance, superior hand contact	Left stance, inferior hand contact
5	Prone reinforced pisiform/ hypothenar - PSIS contralateral contact push	PI ilium, prone, left	Right stance, superior hand contact	Right stance, inferior hand contact
6	Supine thenar/index transverse contact	Anterior thoracic, mid-thoracic spine	Standing on right	Standing on left
7	Prone bilateral crossed pisiform/ hypothenar - transverse contact without counter-rotation	Crossed pisiform, spinous right T6	Stance on left, inferior hand contact	Stance on left, superior hand contact
8	Prone bilateral crossed pisiform/ hypothenar - transverse contact without counter-rotation	Crossed pisiform, spinous left T6	Stance on right, superior hand contact	Stance on right, inferior hand contact

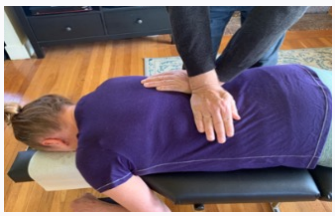
A cluster of 8 manipulative setups was selected (Table 1), each of which required a student to consecutively execute pairs of equivalent setups that differed in either side of stance and/or use of the hands. The particular setups we chose made it particularly easy to maintain the specificity of the adjustive approach even though the side of stance or use of the hands might have been switched. The subjects did not perform any actual manipulative procedures; the only force involved was light pressure on the parts of the simulated patient's body contacted (the segmental contact point).

Four of the equivalent setups in Table 1 (rows 1-3, 6) had subjects address the same static listing, but standing on opposite sides of the table, with requisite changes in whether their dominant or non-dominant hand contacted the simulated patient's segmental contact point. Four of the setups (rows 4-5, 7-8) deployed the same setup for opposite static listings, the subject standing on opposite sides of the table and using either the superior or inferior hand (as directed) to contact the simulated patient's segmental contact point. In Table 1, the 2nd column provides the names of the procedures using terminology evolved by the National Board of Chiropractic Examiners (NBCE), a testing agency for which the first author (RC) had previously served as a consultant.

In 3 data acquisition sessions, pairs of subjects alternated as simulated doctors and patients to perform the required setups on each other. Each student was provided an 8-page booklet that used photographs to illustrate the setups to be performed, starting with Setup 1 and proceeding to the other setups listed in Table 1, going through the 8-page booklet in the order printed. They themselves identified both the version of the setup they preferred and recorded their degree of preference as "strong" or "weak." They were instructed to have no communication with their partners as to their preference choices. They were allotted whatever amount of time they required and worked through the entire booklet without pauses. Each pair of subjects self-selected which person would go first in running through the 8 pairs of skills, after which they reversed their roles, and the second subject ran through all 8 pairs of skills.

Table 2. *Alternative versions of equivalent skills assessed in study*

Procedure	Setup 1	Setup 2	KP
1. Base Posterior, 71.4% preferred **dominant arm contact**			
2. P-R Sacrum, 71.4% preferred **dominant arm contact**			
3. P-L Sacrum, 74.3% preferred **dominant arm contact**			
4. PI Right Ilium, 62.9% preferred **inferior contact hand**			
5. PI Left Ilium, 57.1% preferred **inferior hand contact**			
6. Anterior Thoracic, 54.3% preferred **stance on right**			

Procedure	Setup 1	Setup 2	KP
7. Spinous R T6, 88.6% preferred **superior hand contact**			
8. Spinous L T6, 77.1% preferred **superior hand contact**			

To analyze the data, the preferences of the very few left-handed subjects in the study were combined with those of the right-handed subjects by transforming their data to reflect "dominant arm"; e.g., if a left-handed subject preferred using her or his left arm in a side-posture manipulation, this was analyzed as if this subject had been a right-handed subject preferring the use of the right arm. Left-handed subjects were interviewed after data acquisition was complete to determine if an effort had been made, voluntarily or involuntarily, at any time in their lives to be either ambidextrous or be converted from left-handedness to right-handedness.

The statistical analysis for the categorical data gathered in this study had both descriptive and inferential arms. The descriptive component consisted in reporting preference percentages both for the entire set of subjects as well as for the 3 subsets sorted by the quarter in which the subjects were enrolled. Unpaired t-tests were conducted to compare the average KPs for each of the 8 pairs of equivalent setups in each subset, to determine if there were significant differences in KPs according to quarter of enrollment.

The inferential component of the statistical analysis determined whether the KPs for each of the 8 equivalent setups were significant at the p=.05 level. We calculated a 95% confidence interval for the binomial distribution governed by our sample size, according to the following equation: lower limit=(50%–98%/√n) and upper limit=(50% + 98%/√n), where n=sample size (12).

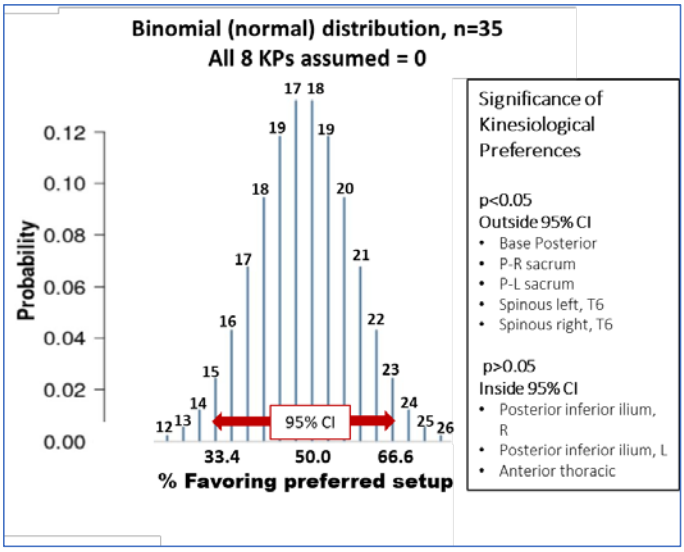


Figure 1. *Binomial distribution, n=35, 95% confidence interval for insignificant KPs*

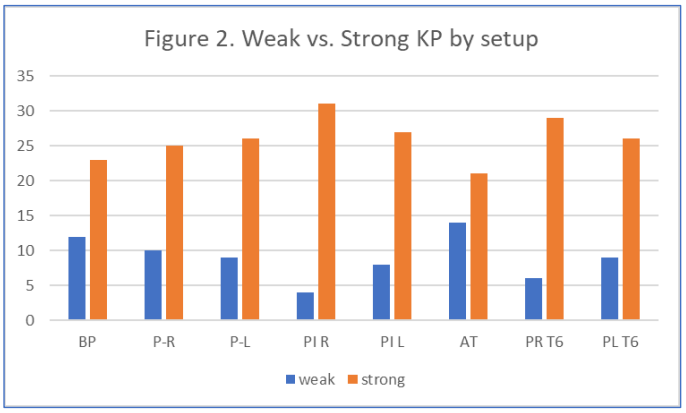


Figure 2. *Weak vs. Strong kinesiological preference sorted by setup*

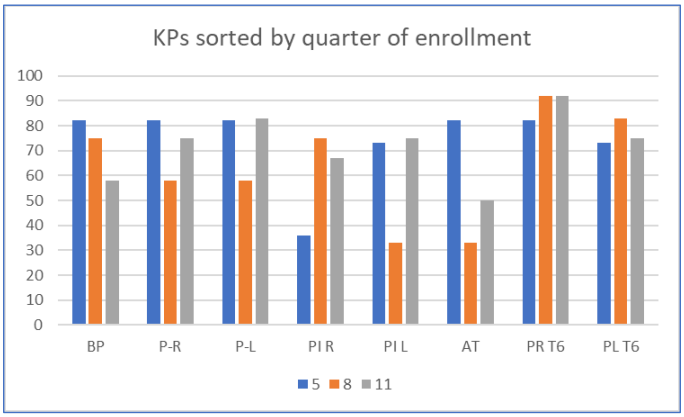


Figure 3. *Kinesiological preferences sorted by quarter of enrollment*

RESULTS

A convenience sample of 35 subjects (54.1% female, mean 27.1 years of age) was recruited from 3 academic quarters (quarters 5, 8, and 11), all of whom satisfied the inclusion criteria. There were 11 subjects in quarter 5, and 12 in each of quarters 8 and 11. There were 3 left-handed individuals, each of whom was contacted following data acquisition to determine if there had been a time in their lives when they had experienced pressure from family members and others to use their right hand rather than left for tasks such as holding a fork or eating; 1 of the 3 confirmed having had such an experience.

Table 2 lists and provides photographs of the 8 pairs of alternative manipulative setups performed in the study, 16 setups in all, and provides the KP percentages for each of the setups in two ways: descriptively in the first column and as pie charts in the fourth column. For each pair of alternative setups, the preferred setup is identified as such, and an asterisk is used to identify the 5 setups where the KP was statistically significant at the p=.05 level, lying outside (to the right) of the 95% confidence interval. The average amount of KP for all 8 setups was 70.4%. It took each student about 10 minutes to execute the 16 skills in the packet.

Figure 1 illustrates the binomial distribution of KPs that would have been expected of 35 subjects who hypothetically had no significant KP for either setup 1 or setup 2; this is identical to the head/tails frequency distribution that would be obtained for 35 flips of a fair coin. For all 35 subjects, the 95% KP confidence interval was within the range bounded by (50% – 98%/√35) to (50% + 98%/√35) (12), which corresponds to 33.4% - 66.6%. Any KP not within this confidence interval would be considered statistically significant, which in the coin flip world would suggest having used a coin that might not have been fair. Figure 1 also identifies the 5 setups where the percentage KP for one of the equivalent setups was outside the upper bound of the 95% confidence interval, confirming the subjects were not indifferent, that they did in fact express a statistically significant preference for one of the setups. In the case of the other 3 equivalent setups, the preference did lie within the 95% confidence interval, and thus could not be distinguished from pure chance at the p=.05 level.

Sorting the data by degree of preference (weak or strong) for alternative versions of a setup, among a total of 280 responses provided (35 subjects, 8 KPs per subject), only 72/280 (25.7%) were rated as "weak". Figure 2 depicts the weak/strong breakdown for each of the 8 preferred setups. The abbreviations used are as defined in Table 1. The anterior thoracic setup, which asked students a KP for standing on the left or right, generated the "weakest" preference, 33.3%.

Figure 3 depicts KPs sorted by quarter for each of the 8 preferred setups. Again, the abbreviations used are as defined in Table 1. Given that 3 possible inter-quarter comparisons could be drawn for each of 8 alternative setups, there were 24 possible comparisons to be made. Unpaired t testing found significant inter-quarter differences in only 2 of the 24 cases: quarters 8 and 11 differed in their KP for setup 5, the PI ilium on the left; and quarters 5 and 8 differed in their KP for setup 6, the anterior thoracic setup. Ultimately, inter-quarter comparison of KPs showed very strong homogeneity; with 24 comparisons having been made, the 2 significant finding were arguably flukes. A Bonferroni-corrected p value would have been 0.05/24, or 0.002, a standard not obtained by any of the comparisons.

DISCUSSION

This study asked the subjects to perform 8 selected pairs of alternative setups for equivalent static listings, to determine if they would consistently exhibit KPs. The results were reported both as percentage preferences and in terms of statistical significance, using the same type of mathematical calculation that is used in political polling, where the uncertainty depends only on the sample size. (12) In 5 cases subjects exhibited statistically significant KPs, and in 2 cases showed an obvious KP that failed to reach statistical significance. In only 1 case, that of the anterior thoracic setup standing on opposite sides of the table, was there only slight KP for a given side of stance (54% preferred the right side of the table).

In the case of the 3 side-posture manipulate setups (rows 1-3, Table 2), there can be no doubt the subjects strongly preferred the version of the setup that allowed them to use their dominant arm to apply the force to the segmental contact. In the case of the setups on the mid-thoracic spine (rows 7-8, Table 2), the subjects strongly preferred using their left arm for the segmental contact

standing on either side of the table, presumably because doing so facilitated using their dominant right arms to effectively reach to the opposite side of the table. In the 2 setups for a PI ilium (rows 4-5, Table 2), the subjects showed substantial (but not statistically significant) KPs for segmental contacts using their inferior arm (right arm when standing on the left side of the table, and left arm when on the right side of the table). Hypothetically, the inferior arm was preferred because this enabled using the superior arm, more directly above the contact point using the typical 45° oblique stance, to generate the bulk of the force. At our chiropractic college this skill is described as a "reinforced pisiform" contact, in which the reinforcing inferior arm would be described as the "hammer" hand". This might explain why the subjects in this study preferred using their superior hands to "reinforce" rather than make direct contact with the segmental contact point. There is evidence that that dominant arm advantages do not apply to all tasks or all aspects of tasks equally. (13)

The anterior thoracic setup (row 6, Table 2) was the outlier, the only setup not exhibiting a KP. We believe this to artifactually reflect the fact there is very little consistency in the way technique instructors at our college teach this setup. Some faculty have the students place their superior hand under the patient's spine, whereas some faculty have them place their inferior hand under the patient by reaching around their torso (the "wrap-around" method). In retrospect, having been aware of this inconsistency from the outset, perhaps we ought not to have included this skill in the study. On the other hand, the lack of KP for the alternative versions of this skill only serves to validate the contrast with the other 7 skills in the study: KPs are only partly intrinsic to the subjects, in that overbearing instructors can have a powerful impact on stifling the expression of intrinsic KPs.

In the chiropractic college where the first author (RC) teaches technique, although the students tend to be more sympathetic to dynamic analysis than static analysis, somewhat paradoxically the indications for the manipulative setups they are learning are usually introduced as corrections of (static) spinal or sacroiliac misalignments. These static listings drive decision making as to the side of stance and which hand is designated as the doctor's contact hand (to be applied to the patient's segmental contact point), even when applied for the correction of dynamic listings derived from motion palpation. That stated, using the example of the alternative mid-thoracic setups described in rows 7-8 of Table 2, if a right-handed student felt more competent or confident standing on the left side of the table, is there any reason to think the training would be more effective were the student required to spend 50% of her/his time standing on the left side of the table? Is there any evidence that the future doctor's clinical outcomes will be made be made safer or more effective over the coming years by choosing side of stance based on static listings rather than KP?

A striking observation to emerge from the analysis was that handedness seemed to only govern technique selection in some of the equivalent skills included in the study. This finding suggests that KP, a broader concept than handedness, may be a better explanatory variable for predicting chiropractic student inclinations. Although we have offered up hypothetical explanations for 7 of the 8 KPs seen in our study, the most salient observation is not so much *why* they existed as the simple fact that *they did exist* – with an average KP over 70%. That stated, at our college and presumably most others, students are trained to use their arms as if they were innately ambidextrous, in a listing-dependent manner.

From a risk/benefit ratio point of view, this practice may be counterproductive, in that technique instructors in both labs and outpatient clinics are to some extent preventing technique trainees from deploying their intrinsic KPs, whether inborn or acquired, whether related to arm dominance or other factors. We are unaware of any substantial evidence that the opinion-based practice of deploying setups based on static listings enhances clinical outcome. Dividing the risk of a less efficient setup by a clinical benefit not known to exceed zero does not make for an attractive risk/benefit profile.

Despite the interest in the development of effective and safe teaching methods of spinal manipulation (14-17), to our knowledge there has been little if any exploration in manual therapy of how KPs interact with the development and delivery of psychomotor skills, for both students and clinicians. The results of the current study suggest teaching and practicing manual therapy skills without regard to handedness and KPs may delay their psychomotor development and/or breed otherwise avoidable anxiety. Learning to deploy psychomotor skills irrespective of KPs might not only retard training but inculcate early postural orientations and hand placements that interfere with the successful acquisition of spinopelvic manipulation skills. Inculcating inefficient manipulative methods might whittle away at the future doctor's comfort, confidence and psychomotor expertise, which is likely to come at the patients' expense.

We are not suggesting that students or clinicians be trained or train themselves to express the KPs that happened to be seen in our study, but rather that they be free to choose techniques less schooled by their instructors and more schooled by the "wisdom of their bodies." (18) That is how many will practice after completing their education. In a study of professional basketball players, who must be capable of using their hands ambidextrously for some of the requisite skills (e.g, dribbling), it was reported that rather than having

had coaches who forced such ambidexterity, players who were already more ambidextrous than the population at large were more likely to go into and succeed in basketball – following the wisdom of their bodies. (19)

In their 2006 paper investigating the effect of visual feedback on HVLA performance by novice operators, Triano *et al.* suggested handedness could potentially confound the explanation of observed outcomes. (20) In their discussion of the results, the authors further indicated that "for an individual, handedness may play a role in the quality of performance (of chiropractic manipulative therapy) from one side to the other." Studies have shown systematic differences in a range of biomechanical parameters between individuals using their dominant and non-dominant hands for tasks. There is evidence that distinct neural control mechanisms are employed for dominant and nondominant arm movements, and dominant arm advantages do not apply to all tasks or all aspects of tasks equally. (13) There is also evidence that forcing an individual to suppress natural handedness is counterproductive, not only due to interfering with function but also because it results in potentially undesirable morphological changes in the brain: in one study there was "disruption of normal structural development that involves a putaminal territory that functionally integrates executive and cognitive control of skilled movements." (21)

Apart from the possible negative consequences of requiring student manipulation trainees to suppress adjustive setup preferences based on KPs, they may be at increased risk of injuring their own bodies in adopting inefficient methods: "It would be in the best interest of chiropractic institutions to use or design new teaching methods and protocols that may prevent injury to students during their training program and optimize safety in the learning of SMT techniques and optimize safety in the learning of SMT techniques." (15)

Limitations of the study

- Data acquisition was well underway when our college campus closed for in-person education and research in the early Spring of 2019. We were not able to resume the project until more than a year later, at which time we felt it imperative to wrap it up even though the sample size of 35 was smaller than the 50 we had initially intended. Our study complied with the observation that a binomial distribution should not be applied to observations from a simple random sample (SRS) unless the population size is at least 10 times larger than the sample size (22). Our college usually has a student population >400.

- The booklet in which the subjects reported their KPs asked them to select either the skill depicted in the left or the right photo. In retrospect, we must consider the possibility that they may in some cases have confused selecting a left or right photograph with selecting the left or right hand as the preferred contact hand.

- There is no obvious way to state with certainty to what degree training in our technique program had already undermined innate KPs, the most important of which was probably handedness.

- The convenience sample of subjects in this study were all enrolled in the same teaching program. Students being trained in a different program might have exhibited different KPs.

- Although this study was undertaken without conducting a power analysis, post-hoc analysis was conducted to provide a heuristic estimate of the impact a larger sample size might have had. It would have required over 100 subjects for the 2 KPs that were statistically insignificant at the p=.05 level to have reached significance. This would not have been possible given the limitations of gathering data during the height of the pandemic.

- We selected a convenience sample of 8 manipulative setups wherein it was particularly easy to maintain the specificity of the adjustive approach even though the side of stance or use of the hands might be switched. The KPs like those seen in our study might not carry over to other manipulative skills.

- It is only hypothetically true that ignoring KPs during training in spinal manipulation could lead to delayed or deficient skill acquisition. There is no evidence to our knowledge that allowing future doctors to set up on skills in the way they believe or feel best suits them results in better clinical outcomes.

- There is potential value in ambidexterity, or some degree of it, were an injury to preclude the deployment of an otherwise preferred adjustive setup.

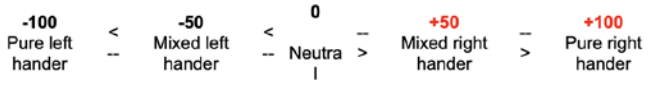
CONCLUSION

We interviewed the 3 left-handed individuals recruited for this study after the fact as to whether they had been pressured earlier in life to develop as right-handed. Two denied such attempts at conversion, but the third wrote back: "I write and throw with my right hand but play all other sports with my left hand or leg . . . My mom grew

Appendix 1. *Handedness Inventory*

This user-friendly online handedness assessment tool is developed with JavaScript. It is based on the Edinburgh Handedness Inventory (11). Please indicate which hand you prefer for each of the following activities.

Task	Left	Right
1. Writing		
2. Drawing		
3. Throwing		
4. Using scissors		
5. Brushing teeth		
6. Using a knife (without a fork)		
7. Using a spoon		
8. Using a broom (dominant hand)		
9. Striking a match		
10. Opening a jar		
Total		



Handedness score is calculated using this formula: 100*((Right - Left) / (Right + Left)).

up in Italy and her parents would slap our hands if we tried to write lefty or eat with our left hand."

This may be the perfect metaphor for what our study suggests we educators have been doing: we have been "slapping the wrists" of manual therapy students for using their hands "the wrong way", perhaps delaying or retarding the development of proficiency in psychomotor skills. We are aware of no evidence that listing-driven setups, and the related stance and hand deployments that typical trainees endure lest they suffer low grades and other sanctions, improves the outcome or safety of spinal manipulative procedures. We suspect that outside the gaze of admonishing technique instructors, trainees likely will do "what works best for them" – but why not make that mostly official?

We suggest educators and even practicing clinicians consider updating their practice methods to be more harmonious with inborn or acquired KPs and less listing-dependent. This could accelerate the development of psychomotor skills, leaving more time to focus on patient assessment, training in ancillary procedures, and case management. It might result in more confident, more effective, and safer practitioners and improved clinical outcomes.

Somewhat hyperbolically, in an emotional article describing the development of left-handed individuals in a right-handed world, 2 Pakistani authors (writing in the English language) conclude as follows: "The experiences of suppression and negative discrimination brought negative impacts on their personalities and made their lives agonized. The support networks which facilitated them and provided relaxation led them towards blissful feeling and resulted in happy and psychologically healthy life" (23).

May we be so erudite in the chiropractic profession.

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