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Pointing to performance ability: Examining hypermobility and proprioception in musicians

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People have varying levels of hypermobility and proprioception that are held to be interrelated. This study sought to investigate hypermobility and proprioception in vocational-level musicians, comparing different instrument groups and examining variables that might account for these differences. Demographic information, handedness, musical background and training, injury history, joint hypermobility, and proprioception were collected from 28 music performance students. The participants had a mean hypermobility score of 2.14 (SD=2.45) with the men exhibiting less hypermobility than the women. While not significant, all instrument groups demonstrated clear differences in proprioception between the left and right hands. For the strings, harps, and pianists, these findings appear indicative of the mechanics of sound production. No significant findings emerged when examining the impact of hypermobility, training, or previous injury on proprioception. The findings support the use of the Leeds Hand Proprioceptometer as a valid means of assessing musicians' finger proprioception and suggest that, in highly trained musicians, the instrument played does influence proprioception.

Keywords: proprioception; hypermobility; musicians; health; training

People have varying levels of hypermobility which can manifest itself in varying ways and in different parts of the body. For musicians, hypermobility has been found to have positive and negative effects (Grahame 1993, Larsson *et al.* 1993). Hypermobility in the fingers can increase hand span, flexibility, and speed for pianists, string players, and guitarists. However, hypermobility can contribute to pain in supporting muscles (e.g. the back and knees) and result in weaker joints, requiring greater force to ensure stability and leading to potential finger and hand pain. Hypermobility has also been found co-occurring in people with impaired proprioception (Mallik *et al.* 1994).

As with hypermobility, people also have varying levels of proprioception. Proprioceptive memory has been found to influence musicians' pitch production, specifically within those possessing absolute pitch (di Carlo 2008). It is also likely that proprioception plays a role in shifting for string players. Proprioception appears to have a close relationship with injury occurrence and rehabilitation. Proprioceptive retraining has been employed as a method of addressing focal dystonia in musicians (Rosenkranz *et al.* 2009), while recent lower limb injuries have been found to negatively impact postural stability in dancers (Clark and Redding 2012).

Research remains conflicted on the role of training and expertise on task-specific and general proprioceptive abilities (e.g. Aydin *et al.* 2002, Schmitt *et al.* 2005). The use of inappropriate measures of proprioception has been proposed to contribute to varying findings and single proprioception tests may not adequately explain, or be generalizable to, the full system involved in proprioceptive ability (Riemann *et al.* 2002).

Given the state of research, this study sought to investigate hypermobility and proprioception in vocational-level musicians, comparing instrument groups and examining variables that might account for these differences.

METHOD

Participants

Six male and 22 female undergraduate and postgraduate music performance students were recruited at Trinity Laban Conservatoire of Music and Dance (mean age=24.67 years, SD=4.35). Of these, there were 11 strings, 2 harps, 3 pianists, 1 woodwind, and 11 vocalists.

Materials

Demographic information, handedness, musical background and training, and injury history was collected using a self-report survey. Participants were assessed for hypermobility according to the Beighton scoring system for joint hypermobility (Beighton *et al.* 1973) and finger proprioception using the Leeds Hand Proprioceptometer (Wycherley *et al.* 2005).

Procedure

Ethical clearance for this study was obtained from the Trinity Laban Research Ethics Committee and each participant provided informed consent prior to testing. The participants first completed the self-report survey. For previous injuries, the participants were requested to record the area, type, and date of the injury sustained. They were then tested for joint hypermobility using the 9-point Beighton scoring system to assess hypermobility in both thumbs, little fingers, elbows, knees, and the lower back (Beighton *et al.* 1973). Each of these nine assessments received a score of either 0 (indicting no joint hypermobility) or 1 (indicating the presence of hypermobility), resulting in a total score ranging from 0 to 9. Lastly, finger proprioception was assessed using the Leeds Hand Proprioceptometer to measure joint position sense in the metacarpophalangeal joint of the index finger of either hand (Wycherley *et al.* 2005). Participants performed position matches twice with each hand: once in which they could see their finger movements and once in which they could not (the latter trials formed the test of proprioception). The degrees of difference between the participant's finger and each target position were recorded with an averaged "score" created for each trial per hand; a lower "score" indicated greater proprioception.

RESULTS

The participants had a mean hypermobility score of 2.14 (SD=2.45). The men (M=1.17, SD=0.98) exhibited less hypermobility than the women (M=2.41, SD=2.67); this difference was not significant ($F_{1,23.07}$=3.19, p=0.087). The participants achieved a mean proprioception score of 5.96 (SD=2.27) with their dominant hand and 5.51 (SD=2.51) with their non-dominant hand. A paired-samples t-test revealed that this difference was not significant (t=0.78, df=27, p=0.440).

In order to control for any potential influence due to handedness the three participants who reported being left handed were removed from further analyses. While the number of participants prevented between-instrument group comparisons, within-group left versus right hand comparisons were possible (see Table 1). Clear differences were observable between the left and right hand Proprioceptometer results for all instrument groups; however, none of these differences attained significance ($p>0.05$).

Exploring for relationships between hypermobility and proprioception, no significant correlations emerged between the total hypermobility scores and the left and right hand proprioception scores (p=0.825 and p=0.617, respectively). A one-way ANOVA was run to examine the impact of hypermobility within the little fingers upon proprioception. Those scored as having hypermobility in their left little finger (n=9, M=4.99, SD=2.37) and right little finger (n=6, M=4.74, SD=1.64) demonstrated greater proprioception than

Table 1. Mean scores (and standard deviations) for joint hypermobility and the Leeds Hand Proprioceptometer according to the difference instrument groups.

Group	*Number*	*Hypermobility score*	*Proprioception left hand*	*Proprioception right hand*
Strings	10	2.91 (2.77)	4.60 (1.86)	6.13 (2.16)
Harp	2	2.50 (3.54)	8.10 (1.98)	5.35 (.021)
Piano	3	4.33 (2.08)	5.60 (3.57)	3.72 (1.75)
Woodwind	1	3.00 (0.00)	3.50 (0.00)	5.00 (0.00)
Voice	9	0.64 (1.29)	5.52 (2.32)	6.83 (2.73)

those without hypermobility (left hand: 5.45, SD=2.34; right hand: 6.38, SD=2.43). Neither of these differences were significant (left hand: $F_{1,16.50}=0.22$, $p=0.643$; right hand: $F_{1,12.62}=3.54$, $p=0.083$).

Six participants reported having sustained a left upper extremity injury and five reported having sustained a right upper extremity injury within the 12 months prior to testing. No significant effects emerged between recent injuries and hypermobility or proprioception ($p>0.05$). Further, no significant effects upon hypermobility or proprioception emerged when considering the age at which the participants commenced formal lessons on their instrument or voice or the number of hours practiced per week ($p>0.05$).

DISCUSSION

All instrument groups demonstrated clear differences (although significant) in proprioception between the left and right hands. Research conducted as part of the development and validation of the Leeds Hand Proprioceptometer noted significant differences between dominant and non-dominant hands with the dominant hand consistently performing better (Wycherley *et al.* 2005). In the present study, this was the case for harp and piano players but not for string and woodwind players and vocalists for whom the non-dominant hand exhibited better proprioception.

For the strings, harps, and pianists these findings appear indicative of the mechanics of sound production: string players perform the more intricate task of fingering with their left hand, harpists watch their left hand but not their right, and pianists typically play more complex lines with their right hand. Years spent playing their instrument may have resulted in an instrument-specific effect on proprioception that superseded the dominant hand preference found by Wycherley *et al.* (2005). Supporting this theory, a comparison of teenaged gymnasts and controls concluded that gymnastic training significantly influenced ankle joint position sense and balance (Aydin *et al.* 2002). While not all studies have reached similar conclusions (e.g. Schmitt *et al.* 2005), the present findings appear to lend support to the possibility of a task-specific practice effect on proprioception. The left versus right hand differences from the woodwind and vocalists are less easy to explain, however, and require further investigation.

No significant findings emerged when examining the impact of hypermobility on proprioception. This is in contrast to research that has found the two co-occurring and concluded that one might influence the other (Mallik *et al.* 1994). In dance, previous injuries have been found to impair proprioception (Clark and Redding 2012); however, the present results did not concur with these earlier findings. A recent study examining general joint hypermobility (GJH), joint hypermobility syndrome (JHS), and injury occurrence in a dance student population found significant correlations between injury and JHS but not injury and GJH (Ruemper and Watkins 2012). The authors recommended employing the Brighton criteria (Grahame *et al.* 2000) in order to better assess the presence of hypermobility.

These findings suggest that musicians have low levels of hypermobility and that, in highly trained musicians, the instrument played does influence proprioception. The findings support the use of the Leeds Hand Proprioceptometer as a valid means of assessing musicians' finger proprioception. In future research seeking to examine the impact of practice behaviors and previous injuries upon proprioception, the collection of more detailed information from a greater number of participants might better elucidate potential relationships. Understanding the extent to which such links function for musicians has implications for the training of musicians and musicians' health.

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