Comparison of Handedness, Athleticism, and Time to Position Under a Paired Sight Trial

K.M. Shipman, D.M. Cutton, and D.J. Burt

Human Performance Laboratory, Department of Health & Kinesiology

Texas A&M University – Kingsville, Kingsville, TX

INTRODUCTION

Proprioception has been examined in a multitude of different situation and studies. Proprioception is defined as "the process of receiving and analyzing information about the position of the body" (Gomes da Costa, 2002, p.1). As demonstrated by Hermelin and O'Connor (1975), proprioception can be tested by excluding the visual sense and performing arm movements in a repetitive manner. The specific type of movement is an important aspect in the development of a proprioceptive study; it can either by horizontal or vertical (angular or linear) (Dodds & Carter, 1983). A horizontal, or angular, movement involves moving the limb from side to side either towards or away from the body; a vertical, or linear movement would be essentially moving the limb up or down. The arm kinesthesiometer has been used in a variety of research studies, and one of its main uses has been in testing proprioception. An arm kinesthesiometer is a device that measures the angle of movement around a joint in 1 degree increments and allows both active and passive movement (Gilford, 1954). It was designed to allow for standardized measurement of kinesthesis which involves the perception of body changes or movements without the use of visual, auditory, or cutaneous senses (Dickinson, 1977). According to Ozmun (1988), the device has been found to have a high sensitivity to arm movements which allows it to precisely test the elbow joint.

PURPOSE

The purpose of this study: The purpose of this study was to determine whether sighted individuals perform better than those with occluded sight (blindfolded) due to proprioceptive awareness with their preferred hand.

METHODS

IRB Approval. The study was approved by the Institutional Review Board (Human Subjects) at Texas A&M University-Kingsville.

Participants. All subjects provided informed consent prior to testing. 48 male subjects and 44 female subjects were recruited from the student population at Texas A&M University-Kingsville. (N=92)

Procedures. Day 1: Subjects filled out a survey and consent form. The survey included demographic questions as well as questions on handedness, video game experience, and athleticism. The subjects were then randomly divided into two groups (n = 46/group): Group A (blindfolded for Session 1) and Group B (blindfolded for Session 2). Instructions were given on how to use and perform movements on the kinesthesiometer. Subjects were then instructed to sit in a chair with their feet flat on the floor. They then placed their arm on the device, with their elbow at the corner and their middle finger pointing to zero (as demonstrated in Figure 1). Subjects in Group A were then blindfolded. They performed three timed trails with both preferred and non-preferred hands. Subjects were instructed to move their arm from 90 degrees (extended straight away from body) towards their body to exactly 30 degrees. Time to position and constant error (+/-) were recorded for each trial. Subjects in Group B performed the same number of trials and were instructed to do the same procedures as Group A, but they were not blindfolded on Day 1.

Day 2: Those who were in Group A completed the same tasks as Day 1, but without the blindfold. Group B subjects also performed the same tasks as Day 1, this time with the blindfold. *It was assumed that all subjects understood the test instructions and tried to perform to the best of their ability on each trial.

Instruments. Time to position was measured by using a stopwatch; the time started on the word 'GO' and ended when the subject's arm stopped moving. Another instrument used was a kinesthesiometer, a tool that allowed the subjects to move their arm a designated number of degrees in a specified direction. A thin poster board was used to cover the numbers noting degrees on the kinesthesiometer. Lastly, a blindfold was used to obscure the subject's vision on specified trials.

Statistical Analysis. Following data collection, examination of demographic data was followed by comparison of same handedness in both the speed in milliseconds and constant error by degree with a dependent samples t-test. Additionally, an independent samples t-test was used to analyze Group A and B aggregated data by session and handedness in comparison of occluded and sighted attempts by speed in milliseconds and constant error by degree. A Levene's Test for Equality of Variances was run to check for homogeneity. The error rate used throughout the entirety of the study was $\alpha = 0.05$.

Figure 1: Kinesthesiometer (Lafayette Instruments). Device participants used to complete their 12 total arm positioning trials.

RESULTS

Table 1: Subject Demographics

Variable	Mean	SD	Range
AGE	23.5	4.8	19-52
GPA	2.9	0.4	2.1-4
Video Gaming	2.9	4.7	0-20
S1Pms	2051.6	965.4	583.3-7583.3
S1NPms	1867.2	830.5	830.0-5836.7
S2Pms	1765.3	693.6	756.7-4786.7
S2NPms	1667.1	618.2	836.7-3983.3
S1Pce	1.7	10.7	-22.3-31.7
S1NPce	3.7	14.3	-19.7-44.0
S2Pce	1.7	12.0	-17.7-41.7
S2NPce	3.3	13.3	-19.3-49.3

Table 2: Dependent Samples t-test

Dependent Samples	Mean	SD	t	Sig. (2-tailed)
S1Pms-S2Pms	286.3	65.6	4.2	.000
S1NPms-S2NPms	200.1	593.5	3.2	.002
POms-PSms	0.9	717.8	0.0	.991
NPOms-NSms	59.6	623.9	0.9	.362
POce-PSce	-0.5	8.4	-0.2	.849
NPOce-NPSce	-0.0	10.1	-0.0	.997

Considering only handedness in the subjects with a dependent samples t-test, the average change in time to position from Session 1 to Session 2, with the subjects using their non-preferred hand in both sessions, was significantly (p=0.0020) faster in the second session by 200.145 msec. In the use of their preferred hand, average change in time to position from Session 1 to Session 2, with the subjects was significantly (p=0.0001) faster in the second session by 286.250 msec.

Table 3: Independent Samples t-test

Independent Samples	Mean	SD	t	Sig. (2-tailed)
S1PSms	2197.8	1165.7	1.4	.161
S2POms	1911.5	709.2		
S1PSce	1.4	8.5	-0.2	.821
S2POce	1.9	12.5		
S1NPSms	1826.1	722.7	2.4	.017
S2NPOms	1516.9	458.9		
S1NPSce	3.3	13.3	-.4	.724
S2NPOce	4.4	15.2		

When comparing the subjects on sighted to occluded sight with an independent samples t-test, only Group B (blindfolded Session 2), demonstrated a significant difference in the average change in time to position, specifically in the non-preferred hand (p=0.0170) at the speed of 309.198 msec. faster in the second session. Equal variances were not assumed based on a Levene's Test for Equality of Variances (p=0.0420).

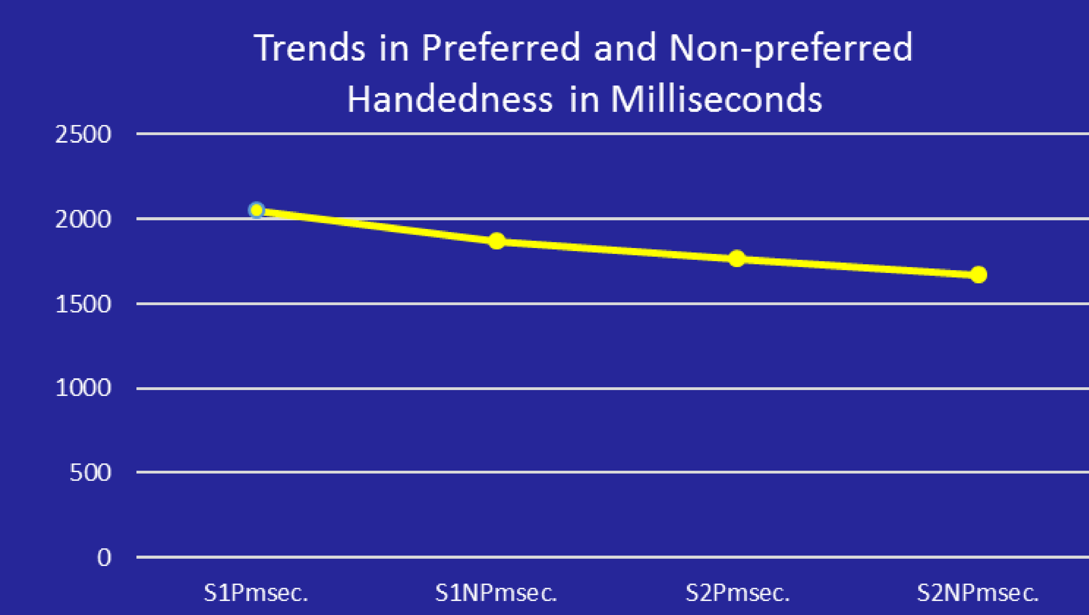

Figure 2: Trends in Milliseconds. It was noteworthy that there was a consistent trend in faster speeds between the first and second sessions. Unsurprisingly, Group B outperformed Group A in the first session of the study as they were sighted on their first attempt.

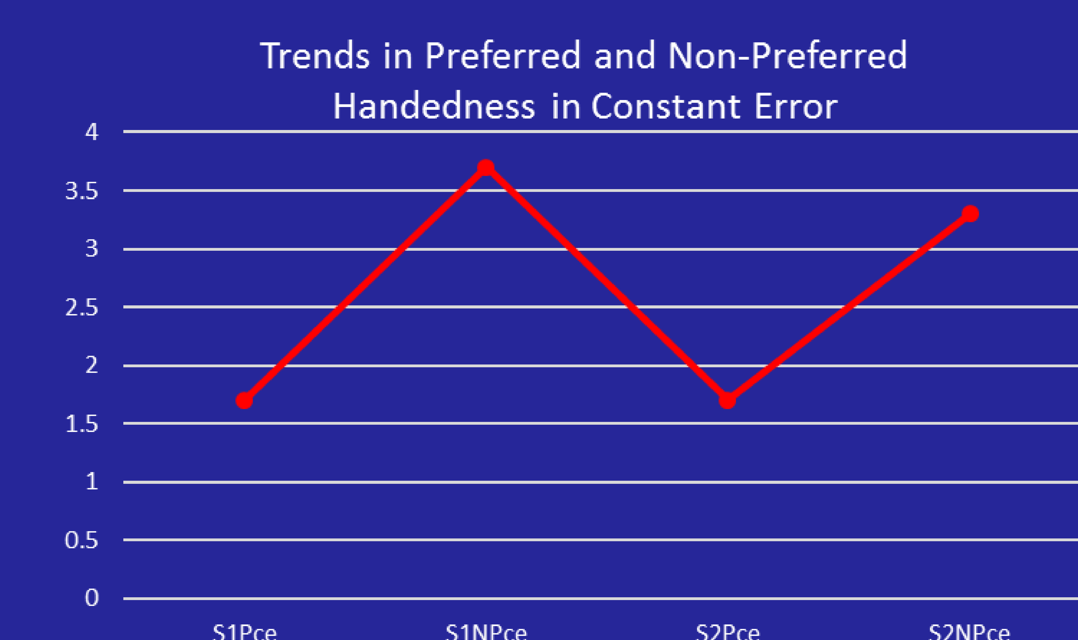

Figure 3: Trends in Constant Error. In the study there was less of a trend in the variable of constant error, including individual groups A and B where there was less change than expected. The most noticeable change was the larger drop in time in the non-preferred hand compared to the preferred hand.

DISCUSSION

The present study confirms the overall trend that on average sighted subjects typically perform with better accuracy and faster speeds than those with occluded sight. However, when considering the issue of handedness, there does seem to be a learning curve wherein more accuracy is not achieved in a short period of required practice time, but may develop a quicker average change in time to position. While this is across all groups, it seems that this phenomenon in this study is enough to overcome the occluded sight in the second session by Group B in their non-preferred hand. Further research should be performed to determine if learning a similar task with the non-preferred hand vs. the preferred hand may be greater because it is typically used to practice speed/accuracy movements less, and therefore may have a higher level of trainability.

REFERENCES

Dickinson, J. (1977). Distance and location cues in retention of movements by a congenitally blind subject. *Journal of Psychology, 97*(2), 215-219.

Dodds, A. & Carter, D. (1983). Memory for movement in blind children. The role of previous visual experience. *Journal of Motor Behavior, 15*, 343-352.

Gilford, J.P., *Psychometric Methods*, McGraw-Hill, 1954.

Gomes da Costa, R. (2002). *Proprioception coding and retention ability in visually impaired and non-visually impaired children*. Unpublished Masters thesis, Indiana University, Indiana.

Heitz, R. P. (2014). The speed-accuracy tradeoff: history, physiology, methodology, and behavior. *Frontiers in Neuroscience, 8*, 150.

Helmuth, L., (2000). Neuroscience: Where the brain monitors the body. *Science, 290*: 1668a-1668a. PMID: 17798201

Hermelin, B. & O'Connor, N. (1975). Location and distance estimates by blind and sighted children. *Quarterly Journal of Experimental Psychology, 27*, 295-301.

Millar, S. (1994). Understanding and representing space: Theory and evidence from studies with blind and sighted children. Oxford: Clarendon Press.

Ozmun, J. (1988). *Neuromuscular and kinesthetic adaptations following strength training of visually impaired and non-visually impaired children*. Unpublished doctoral dissertation, Indiana University, Indiana.