EasyChair Preprint

№ 2008

Handedness of Subjects When Throwing Dart

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November 20, 2019

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Abstract

The handedness of people have an impact on how we interact with the world around us, but how big of an impact does it have on our hand-eye coordination? To test this we decided to conduct an experiment showing the statistical behaviour of participants using their dominant hand vs their non-dominant hand when playing darts. The study explores whether the participants accuracy and precision is affected when using their non-dominant hand vs their dominant hand. Furthermore the study also explores how the change in distance impacts the difference in accuracy with both hands.

The results showed that we could not conclude anything new, but the results indicate that further study with a larger number of samples, could possibly result in proving a difference in accuracy and precision when using your dominant hand vs non-dominant hand when playing darts.

Keywords
Handedness, dart, hand-eye coordination, accuracy, precision.

1 Introduction

An experiment with hand-eye coordination when using your dominant hand (DH) vs non-dominant hand (non-DH) was created. To gather data about this the four subjects in the experiment were to play a game of darts on various distances with both hands. Playing dart requires high concentration along with precise hand-eye coordination, therefore it was the obvious choice for this experiment.

2 Background

Only male participants where used in this experiment. According to David M. Corey and his colleagues [1], "No sex differences were found; the relationship between preference and performance measures was not significantly different for men and women".

Errors in the position, speed, and direction of motion are not the only factor that we need to consider. In order to hit the target, the hand has to move along a trajectory that yields an appropriate combination of position, speed and direction of motion, but the dart also has to be released at the moment that this appropriate combination is reached. From Jeroen B.J Smeets et al. [2], this could be an explanation of why it is more imprecise when throwing with the non-DH.

The test was performed between 9 in the morning and 11 because according to Benjamin Edwards et al. [3], you have to choose the time a day where the muscular performance (which is increasing during the day) and the cognitive performance (which is decreasing during the day) co-align.

2.1 Hypotheses

We presented a number of hypotheses on a dart shooting experiment based on findings from handedness studies. Following the idea that handedness correlates to your capabilities with your hand [1]:
Hypothesis 1. The test subjects would have a higher precision using their DH compared to their non-DH.
Hypothesis 2. The test subjects would have a higher accuracy using their DH compared to their non-DH.
Hypothesis 3. The test subjects accuracy would be affected less from changing distance when using their DH compared to their non-DH.

3 Method

We conducted an experiment to test whether handedness affects your hand-eye coordination when shooting darts. The design of the experiment, experiment procedure, measurements and participant information for the experiment are discussed hereafter.

3.1 Experimental design

The experiment consisted of a dartboard with a partially marked coordinate-system, so each dart position could be measured in x and y distance from center $(0, 0)$, three marked distances at 2, 3 and 4 meters, and six darts that would all be thrown at each distance with each hand. The experiment was conducted using repeatability.

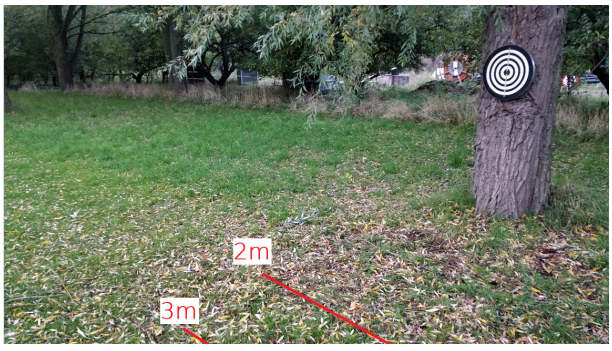

Figure 1: The dart field. Shown with red lines are the 2 and 3 meter throwing distances

In case the dart missed the board, a maximum distance of 25 cm was introduced. We designed the experiment to avoid dependencies between the tests, by randomizing the order at which each test subject would conduct the tests. This was done using a six sided dice which would be rolled before each test to indicate which hand should

be used and at which distance the darts should be thrown from. The order of the participants was decided before the experiment at random.

3.2 Experimental procedure

The experiment was conducted outside in a closed area, with the dartboard hanging on the side of a tree. The random order for the four participants where found, and the first participant would throw the dice. The dice number indicated the test-setup e.g. 4 equalled left hand at 3 meters distance. The participant would throw six darts from the test-setup, and the darts position $\{x,y\}$, would be measured from the center of the dartboard. Each participant would go through each test-setup twice, however this was done in two rounds with a new random order. All of the test-setups must have been completed once before the second round of test-setups could begin.

3.3 Measurement

For our results to indicate both precision and accuracy, the distance from the center is measured as a coordinate system:
Quadrant I = {x,y}, Quadrant II = {-x,y}, Quadrant III = {-x,-y} and Quadrant IV = {x,-y}.

The distance will be measured in cm's with a precision of 1mm.

3.4 Participants

Four participants took part in the experiment after giving informed consent. All participants were male [1], right handed [1], and recruited on the University of Southern Denmark. The ages of the participants ranged from 27 to 35. None of the participants played darts on a regular basis.

4 Results

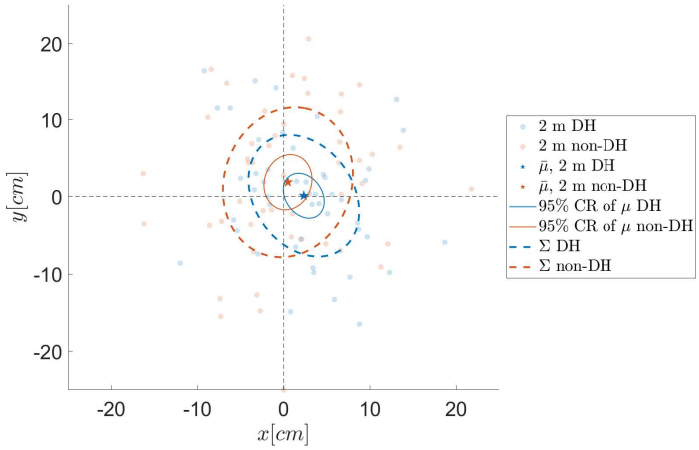

Figure 2: Pooled data: 2 meter DH vs non-DH

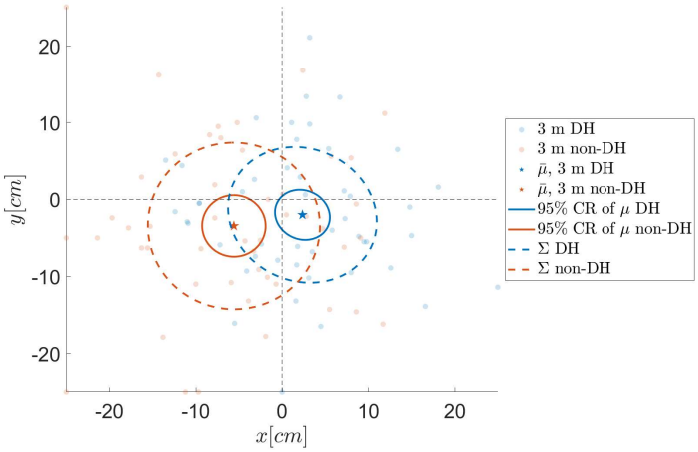

Figure 3: Pooled data: 3 meter DH vs non-DH

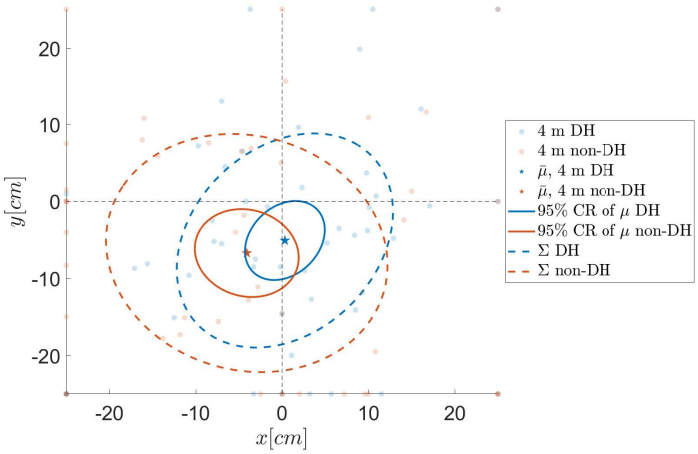

Figure 4: Pooled data: 4 meter DH vs non-DH

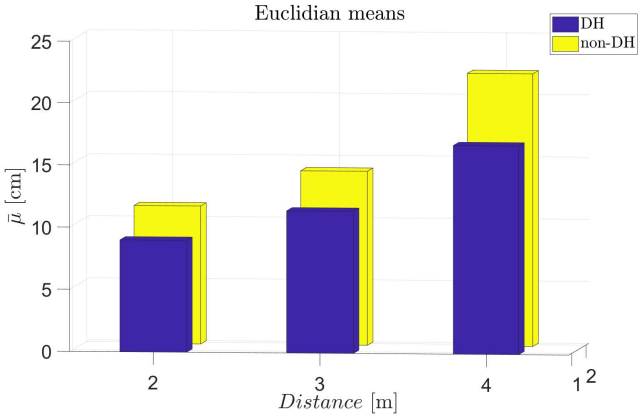

Figure 5: Means of the euclidian distances to origo of the DH and non-DH

Hypothesis 1. To test whether the precision of using your DH vs non-DH is equal, the data from the four participants has been analysed and is illustrated in figures 2, 3 and 4 as the dotted line.

Distance	p-value
2m	0.0788
3m	0.3619
4m	0.0610

Table 1: p-values for equal variances

This table shows the p-value of the two population Barlett's test.

Hypothesis 2. Testing the accuracy of the participants DH vs non-DH the data from the four participants has been analysed and is depicted in figures 2, 3 and 4 illustrated as a star.

Distance	$\mu_{x_{DH}} = \mu_{x_{NDH}}$	$\mu_{y_{DH}} = \mu_{y_{NDH}}$
2m	0.2011	0.3343
3m	0.0001	0.4761
4m	0.1400	0.5884

Table 2: p-values for equal means

This table shows the p-value for the different distances, using Student's t-test.

Hypothesis 3. Testing how distance impacts the accuracy of the participants DH vs non-DH can be seen in figure 5. It is shown that the accuracy is affected more when increasing the distance to the dart board with the non-DH compared to the DH.

Distance:	$\bar{\mu}_{NDH} - \bar{\mu}_{DH}$
2m	2.11 cm
3m	2.56 cm
4m	5.15 cm

Table 3: Difference in mean for the euclidian distance

5 Discussion

The experiment was unfortunately not unaffected by outside factors. As the experiment was conducted in the morning, the participants reported that they felt an effect from temperature and sunlight change. This could have been avoided by conducting the experiment inside a closed environment. Another factor reported by the participants was the effect the previous participants throw had on their own. If the previous participants throws seemed to hit close to center, they reported feeling performance pressure. If however the previous participants throws seemed to hit far from center, they reported being more relaxed. This affect could have been avoided by making the participants unable to see each others throws. Lastly the participants reported that throwing six darts in succession made them adjust for their own previous throws, e.g. if one throw was a little low, they would try to adjust upwards at their next throw. This could have been avoided using replication instead of repeatability. Furthermore the participants were biased due to them knowing about the experiment beforehand. This should have been avoided, for a better study of accuracy and precision. A better estimate of missed shots than using a maximum distance boundary of 25 cm, would have increased the size of the variance, and perhaps changed the outcome of the tests. After analysing the data it was discovered that perhaps splitting hypothesis 2 into two separate hypothesis, one for x and one for y, would have been beneficial for the tests and might have led to another conclusion of the hypothesis.

Limitations - Only used four biased participants with right hand as their dominant hand.

6 Conclusion

Hypothesis 1, we cannot reject that the two populations have the same precision, based on the p-value seen in table 1 with a 95% level of confidence. However with a 90% level of confidence it would be rejected at 2 and 4 meters and accepted at 3 meters.

In hypothesis 2 the p-values of table 2 indicates a separation of the means in the x direction is more prone to be rejected if more data was produced, than a separation in y. At a distance of 3 meters it can be rejected that the means of x are equal, while at 2 and 4 meters it can not be rejected that the means are in fact equal.

Hypothesis 3 is accepted as seen in 3 and 5 because the accuracy of the non-DH is affected more when the distance is increased compared to the DH.

Thus no new information has been learned and it is speculated that this is due to an inadequate amount of samples.

Acknowledgements

We would like to thank Oskar Palinko for playing the amazing villain Sylar in *Heroes*. And for teaching us scientific methods.

References

[1] David M. Corey et al. - Right and Left Handedness Defined A Multivariate Approach Using Hand Preference and Hand Performance Measures - 2001

[2] Jeroen B.J. Smeets et al. - Throwing darts: timing is not the limiting factor - 2001

[3] Benjamin Edwards et al. Effects of time of day and distance upon accuracy and consistency of throwing darts - 2007