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THE EFFECT OF RUNNNING, SHOOTING AND JUMPING DIRECTION PERFORMANCE IN ATHLETICS

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ABSTRACT

Purpose: In this study, to examine the effect of running clockwise and counterclockwise in athletics on the running times of athletes; Again, it is aimed to investigate whether the throwing and jumping directions of throwing and jumping branches have an effect on performance.

Materials and Methods: This study was conducted with the participation of 10 athletes (5 females and 5 males) aged between 18-22 years old, who are actively competing at elite level. Shot put, hammer throw, long jump and high jump performances were recorded, 60 each from east to west and 60 from west to east. In the measurements made twice a week in throwing and jumping branches, 3 throws and jumps were made from east to west and 3 from west to east. On the first measurement day of the week, the first 3 of 6 shots and jumps were made from east to west and the last 3 from west to east. On the other measurement day, the order was made in the opposite way. A rest period of 5 minutes was given between shooting and jumping. The 200m running performance was evaluated on two separate days of the week. On the first measurement day of the week, first 1 run counterclockwise, and 45 minutes later, clockwise jogging was done. On the second measurement day of the week, the running direction order was made in the opposite way. Throw and jump distance were measured in meters. The 200m running time was measured with a photo finish measuring instrument.

Results: Both male and female subjects; hammer throw, shot put, long jump and high jump performances were statistically higher when exhibited from west to east ($p<0.01$). Anti-clockwise running performances of both male and female subjects were found to be statistically higher than clockwise ($p<0.01$).

Conclusion: In athletics, higher performance is exhibited when throwing and jumping from west to east. Performance is higher in counterclockwise runs.

Keywords: Athletics; Clockwise; Counter clockwise; Jump direction; throw direction

1. INTRODUCTION

Athletics is one of the oldest Olympic sports branches, which includes different disciplines and is the focus of attention of many countries in the world. In the first Modern Olympic games held in Athens, Greece, it is known that the athletes ran clockwise in the track competitions during the competitions, and the IOC (International Olympic Committee) reported that the athletes were very uncomfortable and complained about this situation. With a decision taken by the International Olympic Committee, the rule of running counterclockwise has been included in its activity program.

When we look at nature, it is seen that everything moves in the opposite direction of what is known. When we examine our own anatomy, the left side of our body is slightly heavier due to the location of our heart. For this reason, while left turns are more comfortable in running, on the other hand, our body can exhibit the rotation movement faster in activities performed with rotational technique. Looking at this situation from a different perspective, a right-handed athlete turns this situation into an advantage compared to a left-handed athlete. Thus, by taking advantage of this advantage, athletes control their body better and use arm and leg positions more coordinately in counterclockwise runs and rotational technical branches, which allow the athlete to move more comfortably and in a shorter time during turns.

In curved runs on the athletics track and in rotational technical branches for right-handed athletes, they perform the movement counterclockwise, but apart from performing the training correctly and effectively, the trainers analyze the positions in which the athletes can move most comfortably while performing the movements and shape their training in this direction, which will have a positive effect on the performance of the athlete.

When we look at track races, not only running, but also in technical branches such as discus, hammer and shot put, right-handed shooters make the movement counterclockwise in the rotation technique used in shooting (Simone, 2009). The fact that the Greeks were quite good in terms of athletic abilities led to the organization of the Olympics. The biggest feature they looked for in skill tests was how fast the athletes could run against their opponent when necessary (Wordpress, 2007). The Greeks did not have a clock concept, they only knew the right and left of their bodies. With this knowledge, they applied a simple test by running the athletes from left to right on the running tracks, and they concluded that while running from left to right, they would be more successful, but when running from right to left, your running rhythm and speed would be lost (Soldjablue, 2007). The earth rotates counterclockwise, and the moon rotates counterclockwise and follows the earth's orbit. Except for Venus and Uranus, every planet rotates counterclockwise. For this reason, an athlete running counterclockwise with the effect of rotation is more advantageous (Brown, 2011). From the point of view of biomechanics, in the long jump, the athlete will continue to make a forward lunge when he lands, which will keep the body in an upright position by extending his arms counterclockwise during the flight. The fact that the athlete moves his legs with a counterclockwise rotation and moves other parts of the body clockwise during the flight provides positive acceleration to the athlete (Crowell, 2011).

Many scientific studies have been conducted and examined on this branch in the world, but it has been seen that the number of scientific studies on the subject of our research is quite limited. With this research, it is aimed to contribute to the high level performance of the athletes by examining the running, shooting and jumping aspects in the competition. In other words; this research will guide the athletes and coaches about what should be done for the highest level of success, the construction of athletics tracks and also the review of the competition rules determined by the IAAF (International Amateur Athletic Federation). The fact that it will be the first master's thesis study to examine the effect of this subject on performance in the athletics branch in our country will be a model for researchers in the studies to be done in this sense, which will eliminate this deficiency in the field of examining the performance in this branch. In this context, the result of the study; will offer a different perspective to athletes and coaches and enable them to perform their training more efficiently and effectively.

From this point of view, in this study, the effect of running clockwise and counterclockwise in athletics on the running times of athletes; Again, it is aimed to investigate whether the throwing and jumping directions of throwing and jumping branches have an effect on performance.

2. MATERIAL AND METHOD

Subjects

The measurements of this study were carried out at the Ilkadım Athletic Stadium of the Provincial Directorate of Youth and Sports. This study was conducted with the participation of 10 athletes in total, 5 girls and 5 boys, aged 18-22, who are actively competing in athletics at elite level, and who are right-handed. The measurements were made by examining 120 hammer throws, 120 shot put, 120 long jump jumps, 120 high jump jumps and 40 200 m runs. These athletes train 6 days a week. The subjects were asked not to do any exercise before the measurement on the measurement days. The measurements of the athletes were completed in 5 weeks. Measurements were made two days a week (Wednesday and Saturday) and the performances of the subjects were recorded and evaluated in the observation form.

The study was conducted in accordance with the decision of the Ondokuz Mayıs University Faculty of Medicine Clinical Research Ethics Committee (2019/1031). Considering that seasonal differences may affect the results of the study, all measurements were completed within 5 weeks.

Study Method

Necessary information was given to the subjects about the devices to be used in the study and the measurements to be applied. It was held at the Provincial Directorate of Youth and Sports Ilkadım Athletics Stadium. Attention was paid to the fact that the subjects did light training the day before the test and did not train on the test day and were rested. Measurements were taken at 16.00 on Wednesdays and Saturdays for 5 weeks. Measurements were started when the subjects stated that they had completed their general and branch-specific warm-ups and were ready for the test.

The performances of these athletes on Wednesday and Saturday for 5 weeks were evaluated by being recorded in the observation form.

These performances are as follows.

Shot put: 60 shots from east to west, 60 shots from west to east

Hammer throw: 60 shots from east to west, 60 shots from west to east

Long jump: 60 shots from east to west, 60 shots from west to east

High jump: 60 shots from east to west, 60 shots from west to east

200m run: 30 counterclockwise runs, 30 clockwise runs

Shot put: Shot put performance was studied on two athletes, a woman and a man. Each shot putter fired a total of 6 shots on the first measurement day of the week, first 3 eastward (east to west) and 3 westward (west to east). On the second measurement day of the week, the order of the shooting direction was changed and 6 shots were made again. That is, each measurement was performed starting in a different direction from the previous measurement day. These measurements continued for 5 weeks. In other words, in 5 weeks, a female shot putter shot 60 shots and a male shot putter shot 60 shots. Thus, the number of shots of both athletes; There were a total of 120 units, 60 of which were in the east direction and 60 in the west direction.

The shot put was done in the shooting circle. The subjects were right-handed and shot using the gliding technique. The throws were carried out in accordance with the rules of athletics, taking into account the rules of the competition.

Hammer throwing: After the subjects completed their branch-specific warm-ups, they performed their throws in turn, one male and one female. Shots were made inside the shooting

cage and in the shooting room. The weight of the hammer used in the measurements is 4 kg for the female athlete and 5 kg for the male athlete. They also wore shooting gloves on their left hand and special throwing shoes on their feet while shooting. The subjects performed their shots in accordance with the athletics rules, based on the competition environment and rules. Subjects fired 3 eastward 3 westward shots, and each shot was measured with a meter and recorded on the chart. Each measurement was performed starting in a different direction from the previous measurement day.

Long jump: In the long jump, one female and one male subject are based on the race rules for the jumps. The subjects used spiked shoes suitable for the long jump for the jump. In the measurements, 30-45m tartan jogging track was used and the measurement was made by taking into account the closest trace to the stepping board left in the sandbox as a result of jumping into the sandbox by pressing the 20cm white part of the 30cm wide step board (10cm red area foul) and leaving the sandbox. . The result of each jump is recorded in the chart. The subjects made 3 jumps in different directions and started their jumps in different directions (East to West-West to East) on each measurement day.

High jump: A male and female subject, whose measurements were taken in the high jump, while obeying the rules of athletics, using a semi-circle tartan running area of at least 15m, jumping over the lath on the mat without dropping the bar placed between two vertical poles, the height of the lath passed was recorded in the chart. After each passing height, the bar was raised and the subjects continued their jumps. The subjects used high jump special spiked shoes for jumping. The subjects made 3 jumps in different directions and started their jumps in different directions (East to West - West to East) on each measurement day.

Running: A male and female subject performed the 200m sprint run on the weighing track, from a low start and with the sound of a gun, and the measurement results were determined by photo finish. The subjects used sprint spikes for running and starting wedges to perform their climbs. On the first measurement day of the week (Wednesday), the first measurement was taken by running counterclockwise, and after 45 minutes the second measurement was taken by running clockwise. On the second measurement day (Saturday), the first measurement was taken by running clockwise, the second measurement was taken by running counterclockwise, and the results were recorded. The direction was changed on each measurement day.

Statistical analysis

SPSS statistical package program was used to evaluate the data. Whether the data showed normal distribution or not was examined with the Kolmogorov Smirnov test. Paired t test was used if the data showed normal distribution and Wilcoxon sign ordinal test was used if it did not. A total of 520 performances of 10 athletes were analyzed in the study.

3. RESULTS

Table 1: Effect of hammer throw direction on throw distance

	Throw direction of hammer	n	Throw distance (m)					p
			Mean	Standard Deviation	Median	Min	Max	
Male	East to west	30	55,74	0,80	55,53	54,67	57,56	0,00**
	West to east	30	59,96	1,51	59,47	57,98	63,79	
Female	East to west	30	44,86	0,44	44,92	43,83	45,60	0,00**
	West to east	30	48,64	1,03	48,88	46,82	50,38	
Total	East to west	60	50,30	5,52	50,13	43,83	57,56	0,00**
	West to east	60	54,30	5,85	54,18	46,82	63,79	

**p<0,01

It was determined that the hammer throw distance of the male subject showed a statistically significant difference according to the throw direction (p<0.01). Again, the shooting distance of the female subject differs statistically according to the throw direction (p<0.01). The hammer throw distance was found to be statistically significant when both male and female subjects shot from west to east. Hammer throws distance of the subjects regardless of gender; while it was 50.30±5.52 m when shot from the east, it was found to be 54.30±5.85 m when shot from the west. It was determined that the hammer throw distance differed statistically significantly according to the throwing from the east and west directions (p<0.01).

Table 2: Effect of shot put direction on shot distance

	Shot put direction	Throw distance (m)						
		n	Mean	Standard Deviation	Median	Min	Max	p
Male	East to west	30	14,34	0,17	14,30	14,00	14,81	0,00**
	West to east	30	15,15	0,33	15,14	14,71	15,86	
Female	East to west	30	12,74	0,47	12,86	11,80	13,32	0,00**
	West to east	30	13,62	0,35	13,55	12,90	14,40	
Total	East to west	60	13,54	0,87	13,66	11,80	14,81	0,00**
	West to east	60	14,38	0,84	14,55	12,90	15,86	

p<0,001

It was determined that the shot put distance of the male subject differed statistically significantly according to the shooting direction (p<0.01). Again, the shooting distance of our female subject differs statistically significantly according to the shooting direction (p<0.01). Shot put distance was found to be statistically higher when both male and female subjects shot from west to east. Shot put distance of the subjects regardless of gender; while it was 13.54±0.87m when shot from the east, it was 14.38±0.84 m when shot from the west. It was determined that the distance of the shot put differs statistically according to the east and west directions (p<0.01).

Table 3: Effect of long jump direction on jump distance

	Long jump direction	Jump distance (m)						
		n	Mean	Standard Deviation	Median	Min	Max	p
Male	East to west	30	6,45	0,23	6,51	5,89	6,75	0,00**
	West to east	30	6,87	0,13	6,84	6,63	7,12	
Female	East to west	30	5,37	0,09	5,37	5,21	5,57	0,00**
	West to east	30	5,57	0,13	5,54	5,30	5,81	
Total	East to west	60	5,91	0,57	5,73	5,21	6,75	0,00**
	West to east	60	6,22	0,67	6,22	5,30	7,12	

**p<0,01

It was determined that the long jump distance of our male subject differed statistically significantly according to the jump direction (p<0.01). Again, the jump distance of our female subject differs statistically significantly according to the jump direction (p<0.01). The long jump distance was found to be statistically significant when both male and female subjects jumped from west to east. Long jump distance of subjects regardless of gender; while it was 5.91±0.57m when jumping from the east, it was 6.22±0.67m when jumping from the west. It was determined that the long jump distance differed statistically significantly compared to the jumps from the east and west directions (p<0.01).

Table 4: Effect of high jump direction on jump height

	High jump direction	n	Jump height (m) Mean	Standard Deviation	Median	Min	Max	p
Male	East to west	30	1,94	0,05	1,95	1,80	2,03	0,00**
	West to east	30	2,02	0,06	2,05	1,85	2,10	
Female	East to west	30	1,61	0,07	1,61	1,48	1,72	0,00**
	West to east	30	1,66	0,09	1,66	1,50	1,82	
Total	East to west	60	1,77	0,17	1,76	1,48	2,03	0,00**
	West to east	60	1,84	0,20	1,83	1,50	2,10	

**p<0,01

It was determined that the high jump height of our male subject showed a statistically significant difference according to the jump direction (p<0.01). Again, the jump height of our female subject also shows a statistically significant difference according to the jump direction (p<0.01). It was found that the jump height was statistically significant when both male and female subjects jumped from west to east. Jumping height of the subjects regardless of gender; While it was found to be 1.77±0.17m when jumping from the east, it was found to be 1.84±0.20m when jumping from the west. It was determined that the height of the jump was statistically significantly different compared to the jumps from the east and west directions (p<0.01).

Table 5: Effect of 200m running direction on running time

	200m running direction	n	Running time (sec) Mean	Standard Deviation	Median	Min	Max	p
Male	Clockwise	10	23,64	0,22	23,70	23,20	23,85	0,005**
	Counterclockwise	10	22,71	0,24	22,70	22,33	23,13	
Female	Clockwise	10	26,00	0,08	26,00	25,84	26,13	0,005**
	Counterclockwise	10	25,61	0,12	25,59	25,38	25,80	
Total	Clockwise	20	24,82	1,21	24,84	23,20	26,13	0,00**
	Counterclockwise	20	24,16	1,49	24,25	22,33	25,80	

**p<0,01

It was determined that the 200m running time of our male subject showed a statistically significant difference according to the running direction (p<0.01). Again, the running time of our female subject differs statistically significantly according to the running direction (p<0.01). The effect of counterclockwise running of both male and female subjects on running performance was found to be statistically higher. Clockwise, regardless of gender; while it was 24.82±1.21sec when they ran, it was 24.16±1.49sec when they ran counterclockwise. It was determined that there was a statistically significant difference in running time, clockwise and counterclockwise runs (p<0.01).

4. DISCUSSION

In our study, the effects of clockwise and counterclockwise running, shooting and jumping directions on performance in athletics were investigated.

In our study, the hammer throw distance was examined according to the throw direction. The distance of the shots fired from east to west and the distance of shots fired from west to east were compared. As a result of the comparison, it was seen that the distance of the shots made from west to east by both male and female subjects was greater than the distance of shots made from east to west.

Hammer throws distance of all subjects regardless of gender; while it was 50.30±5.52 m when shot from the east, it was found to be 54.30±5.85 m when shot from the west. It has been determined that the distance of the hammer throw differs according to the throwing from the east and west directions. According to our finding, the hammer throw direction affects the distance. It was observed that the performance of the athletes was higher when shooting from the west to the east.

The shot distance was examined according to the shooting direction. The distance of the shots fired from east to west and the distance of shots fired from west to east were compared. As a result of the comparison, it was seen that the distance of the shots made from west to east by both male and female subjects was greater than the distance of shots made from east to west.

In athletics, it is seen that the distance of the throws made from west to east is higher. For this reason, the importance of shooting directions increases in competitions. It is necessary to pay attention to this element in the organization of the competitions.

In the literature, we could not find a full study on this finding of our study. Therefore, no comparisons could be made.

In addition, the human body biomechanically performs the action of pushing more easily than the action of pulling, so while the right side performs a push or forward action, the left side automatically moves backwards (Bayram et al. 2017). This may be the reason why right-handers turn counterclockwise, especially in shot put.

The long jump distance was examined according to the jump direction and the distances of the jumps made from east to west and from west to east were compared, and as a result of the comparison, it was seen that the distance of the jumps from west to east was better for both male and female athletes. A study similar to this finding of our study could not be found in the literature.

In a study conducted in the long jump branch; the long jump branch has been studied in terms of biomechanics. The athlete will keep the body in an upright position by extending his arms counterclockwise during the flight, and the body will continue to make a forward lunge while landing on the sand. This will carry the trace it will leave on the sand further away from the step board. The athlete's movement of legs with a counterclockwise rotation during flight and the movement of other parts of the body clockwise will provide positive acceleration to the athlete (Crowell, 2011).

In our study, the jump heights in the high jump branch were examined and it was determined that the jump heights differed according to the directions in the jumps made in different directions. According to the measurements made; It was determined that both male and female subjects had higher jumps from west to east. Jumping height of the subjects regardless of gender; While it was found to be 1.77±0.17m when jumping from the east, it was found to be 1.84±0.20m when jumping from the west.

The finding of our study shows that, both long jump and high jump performance increase when jumping from west to east. This issue should be taken into account in the trainings and competitions to be made regarding the jumping branch in athletics.

In our literature research, we could not find a study related to this finding of our study. Therefore, no comparisons could be made.

In our study, 200m running times were examined according to running directions, and it was determined that clockwise running and counterclockwise running had an effect on running time. It was found that both male and female subjects' running counterclockwise had a positive effect on running times. Regardless of gender, the 200m running time averages of the

subjects were found to be 24.82±1.21s when they ran clockwise, while it was 24.16±1.49s when they ran counterclockwise.

When the literature was searched, few studies were found examining the running direction. The study of Bayram et al. (2017) supports this finding of our study. In the study of Bayram et al. (2017), the differences between the degrees obtained by running clockwise at two different distances of the athletes running continuously counterclockwise were examined. Male middle and long distance athletes aged 18 years participated in the study. The degrees obtained were obtained as a result of the competition held with an interval of one day. The athletes participated in the competition by getting ready after warming up for 1 hour before the 200m race and 40 minutes for the 1500m race. During the competition, the athletes ran in lane for the 200m race and all the athletes ran in a single series in the 1500m race with two people. The grades of the athletes were determined by 4 referees using a hand chronometer, and the grades held by the head referee were taken into account. When looking at the 200 meters and 1500 meters degrees of the athletes, it was determined that the counterclockwise degrees were better results (Bayram et al 2017).

In a study conducted by physiologists, it was stated that right-handed people use their right side more effectively than their left side, and the reason for this is that the muscle groups on the right side are more developed. It has been emphasized that right-handed athletes have an advantage in running counterclockwise, and they enable them to take longer steps faster by using the thrust of the leg more effectively during turns (Bayram et al 2017).

According to the researchers, being right-handed does not mean using only the right hand. In addition, these people use their right leg effectively. It was stated that the muscle ratio of the right leg is higher and in this case, longer steps are taken with the right leg (Kosog, 1999). The higher muscle ratio in the legs of right-handed people can enable them to perform the left-handed movement more easily. The human brain performs the left turn of the body more easily than the right turn (Bayram et al 2017).

When looking at different studies, physiologists have included the fact that the heart is left-sided, especially in the human body, as an important factor in explaining that it is easier for athletes to run counterclockwise than clockwise. According to them, the fact that the heart is on the left side in humans and animals and running counterclockwise provides an advantage in creating a centrifugal force in the body (Bayram et al 2017).

In another study; In balance losses, the human body tends to fall to the left, which explains that turns and technical hits from the left are easier than to the right (Borysewics, 1985).

When the literature was reviewed, it was stated that the centrifugal force tired and hindered the athlete while running clockwise. Apart from this, an athlete encounters difficulties when running counterclockwise because, as mentioned above, left turns are easier than right turns (Bayram et al. 2017).

Everything on Earth is moving to the right of the northern hemisphere and to the left of the southern hemisphere. For example, Ferris wheels in amusement parks move counterclockwise. It is a Ferris wheel in the world. The global coordinate system is used in movements around the world. The coordinate system is the force acting on the object moving on the earth (Mc Donald, 1952; Bayram et al., 2017)

Looking at the reading direction, in many languages reading takes place from left to right. In some languages, Chinese and Arabic are read from right to left, while Japanese is read from top to bottom. According to Trento, the instinctive counting behavior starts from the left, because the right lobe of the brain is more dominant in visual perceptions than the left lobe. This is not something learned by experience, but an instinctive event (Coghlan, 2010).

Tavakkoli and Jose (2013) stated in their study that the runs should be done counterclockwise. They explained the reason for this as follows. Everything in nature moves counterclockwise. Viewers are better able to perceive runners as they move from left to right - the same way our eyes move when we read. The left side of the human body is slightly heavier than the right due to the heart, and when running counterclockwise, the body tends to lean very slightly to the left, which can be an advantage for most people when running counterclockwise where the right hand/leg is dominant. We move more controlled and faster while running counterclockwise (Tavakkoli and Jose, 2013).

Looking at the natural causes in the world, people run counterclockwise. Because everything in nature tends towards a counterclockwise movement. The counter-clockwise list of natural events is said to be quite effective. It rotates counterclockwise on Earth and follows the orbit of the sun, but also rotates counterclockwise on the moon, following the Earth's orbit. In fact, every planet orbits the sun counterclockwise. Due to the rotation effect of the world, an athlete running counterclockwise can become more advantageous with a faster time difference (Bayram et al 2017; Sprott, 2000; Tavakkoli and Jose, 2013).

CONCLUSION AND RECOMMENDATIONS

As a result of our work; Curious about the effect of the directions on the performance of the athletes, the effect on the hammer and shot put distance in the throwing branch, the long jump jump distance and high jump height in the jumps branch, and the 200 meters running time in the running category were examined.

When the subjects shot from west to east, their hammer and shotgun performances were found to be higher than those fired from east to west. In another measurement made, it was determined that the performance of the subjects from west to east was better at jump distance and height. Again, it was observed that the subjects' running counterclockwise had a positive effect on their running time.

In this direction, it is important to know how we can use our body and mind most efficiently while planning our performance. For this reason, in this research, the direction in which the performance will be exhibited has emerged as a very important factor in order for the efficiency in sportive performance to be at a high level.

It is thought that knowing the differences arising from aspects of athletes and coaches will contribute greatly to the improvement of performance. Therefore, in this study, the effect of aspects on performance was revealed.

Many scientific studies have been conducted and examined on the athletics branch in the world, but it is seen that the number of scientific studies on the subject of our research is quite limited. With this research, the running, shooting and jumping aspects of the competition were examined and it was aimed to contribute to the high level performance of the athletes. In other words, it is expected that the research will guide the athletes, trainers and the competition rules determined by the IAAF, on what should be done for the highest level of success.

As a result, shot put and hammer throw performance in athletics; and long and high jump performance is higher when performed from west to east than when performed from east to west. Another result of ours is that when running counterclockwise, 200m running performance is higher than running clockwise.

REFERENCES

Bayram, M. Doğar, A. V. & Kaldırımcı, M. Atletizmde saat yönü ve tersi koşmanın, atletlerin koşu sürelerine olan etkisinin incelenmesi. Uluslararası Eğitim Bilim ve Teknoloji Dergisi 2017;*3*(3),147-155.

Borysewicz, E. Bicycle Road Racing: The Complete Program for Training and Competition. USA. Vitesse Press, 1985.

Brown, P. Why do athletes have to race around the track in an anti-clockwisedirection? Notes&Queries. The Sporting Life. London: guardian News.//www.guardian.co.uk/not esand queries/query/0.5753;1985-1416,00.html.

Coghlan, A. Chicks count from left to right – just like us: New Scientist: life.http://www.newscientist.com/article/dn19074-chicks-count-from-left-to-right-just-likeus.html#.UdNOfTtgeSo,2010.

Crowell, B. Lightand Matter: Conser vation of angular momentum. Southern California. Fullerton College;2011

Kosog, S. The Dominant Leg. Süddeutsche Zeitung Magazin. Germany. http://www.somatics.de/artikel/for-professionals/2-article/29-the-dominant-leg,1999

McDonald, J.E. The Coriolis Effect. Volume 839 of Scientific Americanoff Motorsports, University of Florida. Neurosciences, Elsevier.1952

Simone, D.J. Racing, Region, and the Environment: A History of Americanhttp://etd.fcla.edu/UF/UFE0024285/simone_d.pdf.2009

Soldjablue, Why do Athletes run around the track anti-clockwise? UK.http://uk.answers.yahoo.com/question/index?qid=20070316060211AAUEFHT ,2007

Sprott, J. C. Seasons, Tides, and Phases of the Moon. Department of Physics, University of Wisconsin - Madison.2000

Tavakkoli, M. H., & Jose, T. P. The reason why do athletes run around the track counter-clockwise? International Educational E-journal,2013; *2*(5), 23-30.

Wordpress. Why do athletes run counter-clockwise?:thinktwice, UK.http://2pat.wordpress.com/2007/11/02/why-do-athletes-run-counter-clockwise/2007