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Debbie Crews, PhD and
Rafer Lutz, PhD

CHAPTER 27
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An Analysis of Eye and Club Face Alignment
at Address in Putting

James MacKay, OnePutt Enterprises, Inc.

ABSTRACT

The purpose of this research was to explore the relationship between the alignment of the eyes and the club face in relation to the target line at address in putting. Thirty putts from both professional and amateur right-handed golfers' were recorded using an ASL Eye Tracking System and Quintic Video Analysis Software to capture and measure the angle of the subjects eye alignment and club face alignment at address in relation to the target line. Golfers used their own putter and were instructed to take their normal stance and putting stroke on a straight five-foot putt. The video data (recorded at 30 frames per second) of each putt was measured at the frame before the putter started to move in the back swing. The results showed a correlation between the eye alignment angle and putter face angle at address.

Keywords: putting, eye alignment, face angle

INTRODUCTION

Putting accounts for over 43% (Pelz 2000) of the average golfers' strokes. The putting stroke may seem like the simplest swing in golf to perform, but many golfers struggle to perform the task successfully. In relation to the analysis that has been done on the putting stroke and the biomechanics of the putting motion itself, little research has been done with regard to the role the eyes and vision play in putting.

Of the research done with regard to eyes, vision, and putting, Dr. Joan Vickers work is the most recognizable. Dr. Vickers is a professor of kinesiology at the University of Calgary, in Alberta Canada. She has been conducting research in numerous sports including golf using eye tracking equipment for over 15 years. In her Golf Digest article (Vickers 2004) she outlines her findings in studying focus & fixation patterns as well as brain activity of the golfer while putting. Using eye tracking equipment she was able to determine optimal dwell times and patterns for focus on the ball, hole, and target line.

Dr. Craig Farnsworth, referred to as "The Putt Doctor", is one of the world's foremost athletic vision training specialists. He has been the putting coach for over 40 tour players and operates the successful See and Score Golf School in the US. In his book (Farnsworth 1997) he states "Most players perceive the hole to be left or right of its actual location. Through repetition, the player attempts to compensate for a putt they believe they pulled, for example, by opening the blade at impact or slicing the stroke – they learn this is the only way to get the ball close".

Harold Swash is referred to as "The European Putt Doctor". He holds numerous patents on putter design and has developed many successful putter training aids in his 40 year career. He has coached over 40 tour players including 8 of the 12 European Ryder Cup players on the 2006 team and operates the successful Harold Swash Putting School of Excellence in the United Kingdom. In his putting DVD (Swash 2005) his 1st fundamental is "The blade of the putter needs to be square to the target at both address and strike position".

For the purpose of this study, we define eye alignment as the imaginary line which connects one eye to the other. To identify this line we relied on an eye tracking system that tracks and records the subject's eye movement and focus within their field of vision.

This research was done to determine what if any effect the alignment of the eyes, in relation to the target line, has on a golfer's ability to square the putter face to the target at address.

METHOD

Participants

Ten experienced right handed male golfers were used. Participants volunteered to participate in this study and they were not paid. Participants ranged in age from 40 to 60 years old, all with at least ten years of golf experience. Handicaps ranged from 0 (professional golfers) to a high of 20.

Apparatus

Testing was done indoors using an eight foot long by 16" wide putting mat with the ball being placed five feet from the hole. The mat was placed on a level floor and no break was detected left or right of the hole. The mat had a regulation size golf hole that was 1 1/4" deep and there was a 5

degree slope beginning 9" from the hole. The stimp meter estimate was 12 to 13. The mat was white in color and had a 1/8" light red line running (visible to the golfer) from the ball to the hole imprinted on it. An ASL Eye Tracking System was used to capture the video information regarding eye alignment and putter position. The Eye Tracking System used was the ASL Mobile Eye. It is extremely light weight, with the head mounted optics weighing just 76 grams and provides total freedom of movement. The eye tracker has two miniature cameras (recording at 30fps) mounted on what looks like a pair of safety glasses. One camera is focused on the pupil and captures the reflection of a small light source on the cornea. This light can not be seen by the subject wearing the eye tracker. The second camera records the subject's gaze (scene). The two videos are simultaneously captured and uploaded through a small wire connecting the glasses to a small DVR recorder located in a small pouch the subject wears around their waist. Once recordings have been completed, the DVR is removed from the pouch and connected to a computer. The videos are then transferred to the ASL eye tracking software which overlays the focus point (in the form of a cross hair or circle) on to the scene video. Quintic Biomechanics Video Analysis Software was used to analyze the videos and measure eye and putter alignment.

Procedure

Each golfer was calibrated on the eye tracking system using a nine point pattern with the golfer in their putting stance. Each golfer was told the putt was a straight putt and they were given the opportunity to warm up and hit 5 putts wearing the Eye Tracking System before testing began. Each golfer used their own putter and was instructed to take their normal stance and putting stroke on the straight 5 foot putt. After the initial 5 practice putts were taken, the golfer took 3 putts that were recorded. The video was recorded but not transferred to a computer while the putts were being taken. The tester and the golfers were not aware of the results (angle of eye and putter alignment in relation to the target line) while testing was occurring. The video (recorded at 25 frames per second) was uploaded to a computer after all testing was completed. The video was loaded into Quintic Biomechanics Video Analysis Software where each putt was analyzed at the frame before the putter started to move in the back swing. Measurements were taken for the angle of eye alignment and putter face alignment in relation to the target line of the hole.

RESULTS

Table 1 outlines the results analyzed for each putt. For each putt, the difference, in degrees, between the eye alignment at address and target line are displayed including whether the difference was closed (left) or open (right) of the target. The same information is provided for the club face alignment at address in relation to the target line as well as the difference between the eye and club face alignment at address. Accuracy of the results is within one degree. Using a Pearson-product correlation coefficient ($r = .91, p < .001$) we determined that the correlation of eye alignment and putter face alignment was significant.

Since we were using video recorded at 30 fps it is not possible to accurately capture the moment of impact in the putting stroke. We therefore could not accurately measure either the eye alignment or club face alignment at impact. Since we were not able to accurately measure either alignment at impact, and since many physical movements occur during the putting stroke which were also not recorded, we do not feel the outcome of the putt (whether it was made or missed and to which side) would be relevant to the analysis of eye alignment and putter face correlation at address.

Table 1 Difference Between Alignment & Target Line.

Putt Number	Eye Alignment		Club Face Alignment		Diff. between Club Face & Eye
	Degree s	C or O of Hole	Degree s	C or O of Hole	
1	6.10	Open	5.12	Open	0.98
2	6.22	Open	6.22	Open	0.00
3	7.56	Open	6.79	Open	0.77
4	3.46	Open	2.51	Open	0.95
5	1.23	Open	1.20	Open	0.03
6	1.22	Open	1.22	Open	0.00
7	0.00		0.00		0.00
8	1.53	Open	1.53	Open	0.00
9	4.71	Open	3.11	Open	1.60
10	4.53	Open	4.53	Open	0.00
11	2.56	Open	2.56	Open	0.00
12	3.52	Open	3.52	Open	0.00
13	4.71	Open	4.71	Open	0.00
14	3.89	Open	2.36	Open	1.53
15	2.35	Open	0.84	Open	1.51
16	0.00		0.00		0.00
17	3.58	Open	3.58	Open	0.00
18	5.52	Closed	0.33	Closed	5.19
19	0.00		0.00		0.00
20	1.91	Closed	0.40	Closed	1.51
21	0.00		0.00		0.00
22	2.25	Closed	0.28	Closed	1.97
23	2.97	Open	2.46	Open	0.51
24	1.43	Open	1.17	Open	0.26
25	3.26	Open	2.41	Open	0.85
26	4.15	Open	4.15	Open	0.00
27	5.27	Open	5.27	Open	0.00
28	3.75	Open	3.10	Open	0.65
29	2.25	Open	2.00	Open	0.25
30	1.65	Open	1.65	Open	0.00

DISCUSSION

The purpose of this research was to explore the relationship between eye alignment and club face alignment at address in putting. Using a Pearson-product correlation coefficient ($r = .91$, $p < .001$) we determined that the correlation of eye alignment and putter face alignment was significant. Of the 30 putts recorded, 24 (80%) had a difference of 1 degree or less which is the accuracy level of the study. Fifteen of the 30 putts (50%) had the exact same eye and club face alignment. While our study proves correlation, it does not prove which one may be leading the other.

This study may shed new light on Dr Craig Farnsworth's statement "Most players perceive the hole to be left or right of its actual location. Through repetition, the player attempts to compensate for a putt they believe they pulled, for example, by opening the blade at impact or slicing the stroke – they learn this is the only way to get the ball close". Eighty percent of putts had an eye alignment either left or right of the hole. Of the 15 putts where the eye and club alignment were different, all but one had the club face aligned closer to the target line than the eyes were aligned. Could this be an indication that over time and with unsuccessful putting attempts while playing golf, the golfer has consciously or subconsciously recognized the need to adjust the club face alignment from what the visual eye alignment is providing?

Now consider Harold Swash's 1st fundamental, "The blade of the putter needs to be square to the target at both address and strike position". In only 6 of the 30 putts was the difference between eye and club face alignment greater than 1 degree. In 4 of those 6 putts, the club face alignment was less than 1 degree from the actual target line; could this be a further indication that the golfer has developed an adjustment or correction to be more successful in putting.

Twenty three of the 26 putts where the eye alignment was not parallel to the target line had the alignment right of the target. Since only right-handed golfers were used for this experiment, proper data isn't available to conclude that right handed golfer will statistically misalign to the right and left-handed golfers to the left.

Of special interest is the fact that only 4 putts had the eye alignment parallel to the target line. With 80% of this study's putts not having eye alignment parallel to the target line, and considering both Dr. Farnsworth and Mr. Swash's statements, this study would suggest that visual alignment may be the root of many golfers putting problems.

A future study is necessary to try and prove which alignment leads the other. That study could also examine the alignments at impact as well as the effects on the biomechanics of the putting stroke to visual alignment changes.

APPLICATION

While this was a small sample, there is a clear indication that there is a correlation between eye alignment and club face alignment in putting. Furthermore, this study would suggest that most golfers have difficulty aligning their eyes to the target line. Larger experiments using left handed golfers could better define if patterns exist and for which direction left or right of the target line a golfer may generally misalign. Future research may also have a benefit to putter manufacturers. Can the design of the putter head help a golfer better align their eyes to the target? Additionally, are certain visual styles or characteristics of the putter better suited for certain golfers? Testing could be done to identify if left or right eye dominance has an effect on alignment. Ultimately, more research needs to be done.

Many practice aid devices and software programs exist that show putter face alignment in relation to the target (hole). Instructors may need to look more closely at club face misalignment as a symptom of the problem as opposed to the cause.

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