

Use of Ball Line as an Alignment Aid in Putting

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When standing sideways to the ball, it becomes very difficult to see the veridical line of putt to the target and players often misread the direction. The purpose of the study was to determine if using a line on the ball aids putting. Twenty-four expert and twenty-four novice players each made a total of 40 putts, 10 putts each with and without using a line on the ball at distances of 1 m and 4 m away from the hole. When using a line on the ball, players were asked to stay behind the ball, align the ball line toward the target line, and then make the putt. Using a ball line did not aid in any aspects of putting including bias, accuracy, and consistency. In addition, experts who use ball line neither align nor perform better than those who do not use the ball line.

Keywords: golf ball, ball alignment, visual perception, direction illusion

Many golf enthusiasts would agree that the expression “Drive for show and putt for dough” is an accurate statement regarding effective play in the game of golf. Some who disagree with this assessment might say that driving a ball in the fairway is more important and still others might say hitting greens in regulation is most important. While these are important and are certainly desirable, it does little good to hit a drive 300 plus yards in the fairway or hit greens in regulation; if you cannot putt the ball into the hole, you will not score well. Consistently putting accurately is the quickest way to improve one’s score.

In sport science, there is a growing awareness that successful putting involves more than proficient movement control. It requires, apart from many other factors, skillful perception (van Lier, van der Kamp, & Savelsbergh, 2011). Karlsen, Smith, and Nilsson (2008) have argued that stroke execution has relatively minor influence on direction consistency in golf putting among elite players. Golf instructional literature is increasingly emphasizing visual perception as key to success in golf putting (Farnsworth, 1997; Mangum, 2008; Pelz, 2000). When putting, players have to align the path of their swing through the ball with a specific target or target line.

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To do this, they must make a judgment about the intersection of a line in space and a point (Johnston, Benton, & Nishida, 2003). Judgments of geometrical properties in three-dimensional space, however, are frequently unreliable (Blank, 1953; Cuijpers, Kappers, & Koenderink, 2000; Indow, 1991; Koenderink & van Doorn, 1998; Koenderink, van Doorn, & Lappin, 2000; Luneberg, 1947).

Johnston et al. (2003) found that standing to the side of the golf ball to putt creates an illusion of where players believe the target is located. For example, when participants stood to the left of the ball, they believed the target was to the right of its true location. Conversely, when subjects stood to the right of the ball, their perception was that the target was to the left. Such perceptions suggest that individuals who are more successful at putting have developed a strategy for compensating for this illusion. Compensation in putting may be primarily motor learning and/or a willingness to consistently aim in a direction that generates the desired effect even though it seems contrary to perception (Johnston et al., 2003).

Players have employed a variety of strategies to avoid or at least minimize this illusion. Sam Sneed, for example, used a face-on or side-saddle putting alignment to enhance his putting effectiveness. In a recent study van Lier, van der Kamp, & Savelsbergh (2010) found that keeping the eyes directly above the ball when putting helped reduce perceptual error. In another experiment of that same study, they found that keeping the head horizontal to the ground while putting also diminished perceptual error.

Professionals have well established routines to accurately align themselves for putts. Their routines often include standing behind the ball and picking a target relatively close in front of the ball with which to align themselves. A technique some players use to overcome errors in perceived direction is using the logo on the ball as an alignment aid (Farnsworth, 1997). In addition, it appears that many professionals and low handicap golfers mark their ball with a straight line which they believe helps with proper alignment.

The purpose of this study was to determine if use of a line on the golf ball enhances putting success among expert and novice golfers. We attempted to seek answers to two questions: 1) Can players putt more successfully when putting with ball line? and 2) Do experts who use ball line, align the ball and putt more successfully?

Methods

Participants

Twenty-four (18 males, 6 females; 27 ± 13.7 yrs.) expert players and 24 (13 males, 11 females; 20.8 ± 1.8 yrs) novice players participated in the study. One male expert was left-handed and all other players were right-handed. Expert players had an average USGA handicap index (HI) of $+1.4 \pm 2$ and were all below 3 HI, and the majority were Division I collegiate golfers on either a men's or women's team. Novice players did not have an established HI and many had never played golf. Among the experts, 10 players indicated that they use ball line as an aid when putting in competition and 14 players did not.

Equipment

The study was conducted indoors on a flat artificial green. A camera was positioned 3 m above the ground just behind the participant to capture the line on the ball. SAM PuttLab system was used to measure 3 aims of the putter head to the target. The aim to the target is expressed in degrees with a positive value indicating an aim to the right and a negative value to the left. Special goggles (PLATO) were used to occlude vision immediately after ball impact (see Figure 1). Experts used their own putter but all novices used the same blade putter.

Procedure

Prior to the start of data collection, participants were allowed to warm-up and putt on other holes to get familiar with the putting surface. Before testing, we measured the participants' closeness to the ball in stance and their head positions, and determined their eye-dominance. While participants assumed their putting stance and got ready to putt a ball, another golf ball was dropped from the eye closest to the target. Then, after locating where it dropped on the ground, we measured the



Figure 1 — Experimental setup.

Table 1 Possible Influencing Factors of Perceiving Target Line in Putting

	Ball-Head	Head Position	Eye-Dominance
Expert	3 ± 3.1 cm	11.7 ± 5.6°	14 R & 10 L
Novice	13.7 ± 9.3 cm	23.3 ± 9.9°	13 R & 11 L

Note. Ball-Head: ball to head perpendicular distance measured from ground.

Head position: measured from horizontal. R = right eye. L = left eye.

shortest (perpendicular) distance to the target line. We also measured their head position (from horizontal) with a goniometer by placing the axis near the ear and the two adjacent arms along the longitudinal axis of head and horizontal plane. As shown in Table 1, experts kept their head closer to the ball and more parallel to the ground compared with novices. Eye-dominance for both experts and novices was nearly equal.

There were two-length putts (4 m and 1 m) and two putting tasks (ball line and no ball line). Each participant performed 10 putts for each putting task from two lengths. Both lengths and tasks were counterbalanced and randomized. In the ball line putting task, participants crouched directly behind the ball and aligned the line on the ball as close to the perceived target line as possible. In the putting task without the ball line, the ball logo or the line was moved to the side of ball so players could not use either of them. For novices, a brief instruction on the grip was given so that they knew how to hold the putter. Both lengths were straight line putts and to ensure the straight line putt of 4 m length, 10 successful putts were selected and the range of the aims of putter head at impact was measured at 1.50 degrees which is within the acceptable margin of error of 1.55 degrees.

Data Analysis

Three error scores were measured in degrees from the aim of each putt: constant error, absolute error, and variable error. These three error scores indicate bias, accuracy, and consistency of aim, respectively. On each error score, a 2 (Skill: expert, novice) × 2 (Length: short, long) × 2 (Task: ball line, no line) × 3 (Aim: address, impact, path) ANOVA with repeated measures on all factors except Skill was performed. The three aims were aim of putter head at address, aim of putter head at impact, and aim of the path of putter head through impact. Further analysis was done comparing players who normally use the ball line versus those who do not. Means were considered significantly different when the probability of a type I error is .05 or less. If the sphericity assumption was violated, Huynh-Feldt corrections for the *p*-values were reported. Partial eta-squared (η_p^2) values were computed to determine the proportion of total variability attributable to each factor or combination of factors. Post hoc comparisons were performed using *t* test with Bonferroni corrections.

Results

In constant error which indicates putting bias, a significant effect was found only on Aim, $F(2, 68) = 3.73, p = .03, \eta_p^2 = .10$, observed power = .66. No other main effects and no interactions between any factors were found. While both putter head at address and impact were aiming slightly to the right of target, the path of putter was aiming to the left of target. At impact, novices tend to aim slightly more to the right of target than experts on 4 m putt, but no interactions were found (see Table 2).

In absolute error which indicates putting accuracy, significant main effects were found on Skill $F(1, 34) = 16.64, p < .01, \eta_p^2 = .33$, observed power = .98, and Aim $F(2, 68) = 9.05, p < .01, \eta_p^2 = .21$, observed power = .97. Significant interactions were found on Length \times Aim $F(2, 68) = 5.06, p = .009, \eta_p^2 = .13$, observed power = .80, and Skill \times Length \times Aim, $F(2, 68) = 6.35, p = .003, \eta^2 = .16$, observed power = .89. On the main effect of Aim, Bonferroni post hoc analysis showed differences between address and path and between impact and path. The aim of putter path through impact was less accurate compared with the aim of putter head at address and at impact, except for novices on long putts. Experts were more accurate than novices, but using the ball line when putting did not aid either group (see Table 3).

Variable error which was used to illustrate putting consistency showed similar results as absolute error, with significant main effects found on Skill $F(1, 34) = 87.92, p < .01, \eta_p^2 = 0.72$, observed power = 1, and Aim $F(2, 68) = 32.13, p < .01, \eta_p^2 = .486$, observed power = 1. Significant interactions were found on Skill \times Aim, $F(2, 68) = 12.41, p < .01, \eta_p^2 = .27$, observed power = .995; Length \times Aim $F(2, 68) = 10.43, p < .01, \eta_p^2 = .24$, observed power = .99; and Skill \times Length \times Aim, $F(2, 68) = 8.60, p < .01, \eta_p^2 = .20$, observed power = .96. Just as in absolute error on Aim, multiple comparisons showed significant differences between address

Table 2 Constant Error of Aim in Two Putting Tasks

Aim	Short		Long	
	Ball Line	No Line	Ball Line	No Line
Expert				
Address	.62	.36	.55	.63
Impact	.84	.62	.60	.69
Path	-.32	-.46	.05	.14
Novice				
Address	.10	.35	.28	.67
Impact	.58	.69	1.30	1.40
Path	-.59	-.30	-.05	-.34

Note. Address: aim of putter head at address. Impact: aim of putter head at impact. Path: aim of putter head path through impact.

and path and between impact and path. Both the aims of putter head at address and at impact were more consistent than the aim of putter path through impact. Interactions seem to indicate that the consistency of an expert’s putter path through impact was not much different from that of the aim of putter head at address and at impact, but the consistency of novice’s putter path was much less than the other two aims, especially with short putts where the error was nearly twice as much as the others (see Table 4).

There was little difference when comparing experts who normally use a ball line with those who do not. As shown in Figure 2, in all three error scores, there was no significant difference between the two groups regardless of the putting task and whether it was the aim of putter head at address or at impact. In addition, when comparing ability to align the ball line to the target line, there were no differences between the two groups of experts in all three error scores. Players who reported that they use the ball line in competition did not align the ball line with less bias, greater accuracy and consistency than those players who do not use ball line. Nonusers had a bias to the right and users to left but the difference was only about 0.2 degrees (see Figure 3).

Table 3 Absolute Error of Aim in Two Putting Tasks

Aim	Short		Long	
	Ball Line	No Line	Ball Line	No Line
Expert				
Address	1.27	1.19	1.06	1.06
Impact	1.33	1.20	1.34	1.47
Path	1.79	2.13	2.12	2.08
Novice				
Address	2.04	2.31	2.64	3.02
Impact	1.78	1.96	2.76	3.08
Path	3.24	3.38	2.58	2.80

Table 4 Variable Error of Aim in Two Putting Tasks

Aim	Short		Long	
	Ball Line	No Line	Ball Line	No Line
Expert				
Address	.68	.62	.71	.72
Impact	.67	.66	.74	.78
Path	.90	.91	1.02	.85
Novice				
Address	1.59	1.67	1.79	2.15
Impact	1.71	1.70	2.26	2.70
Path	3.22	3.00	2.52	2.67

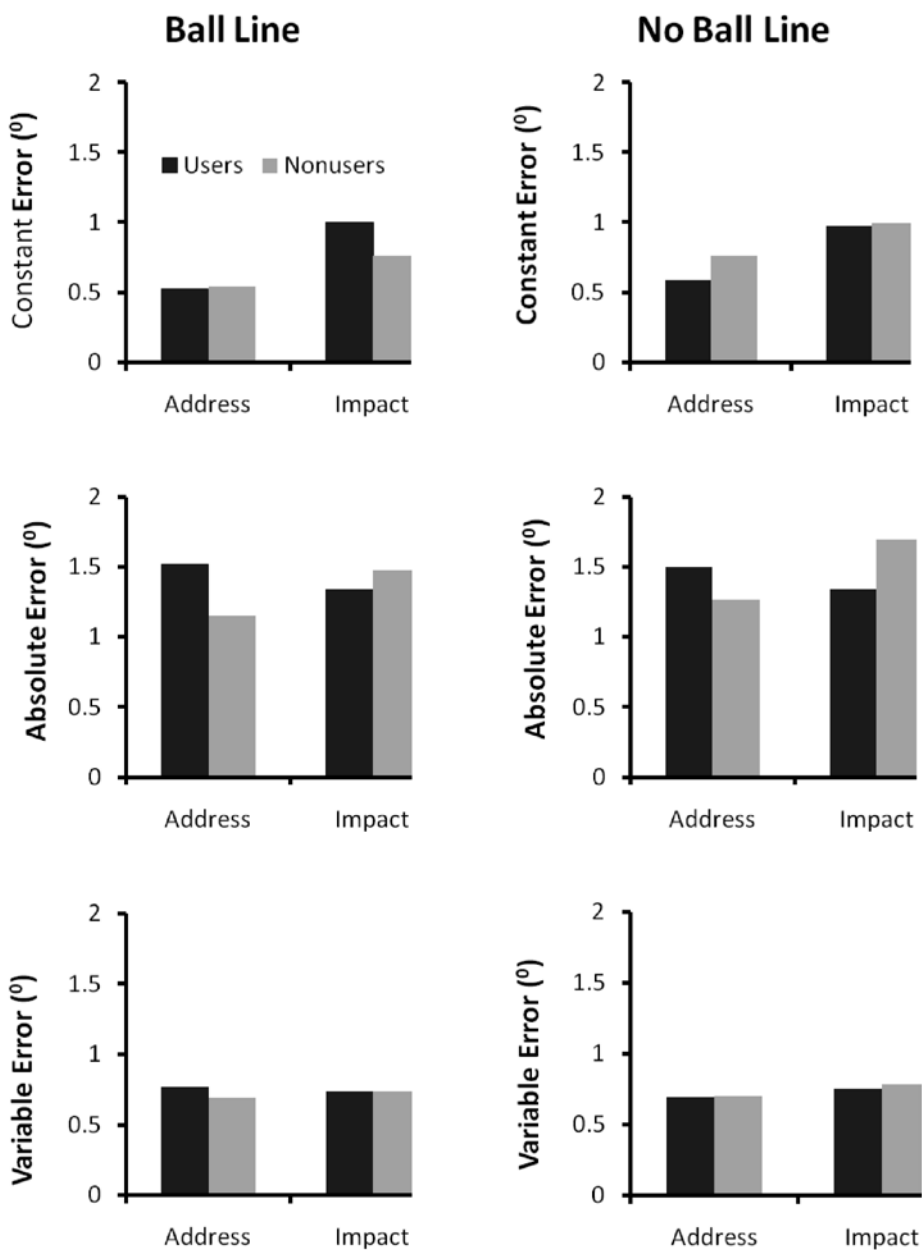


Figure 2 — Aiming errors on 4 m putts by experts who were ball line users vs nonusers.

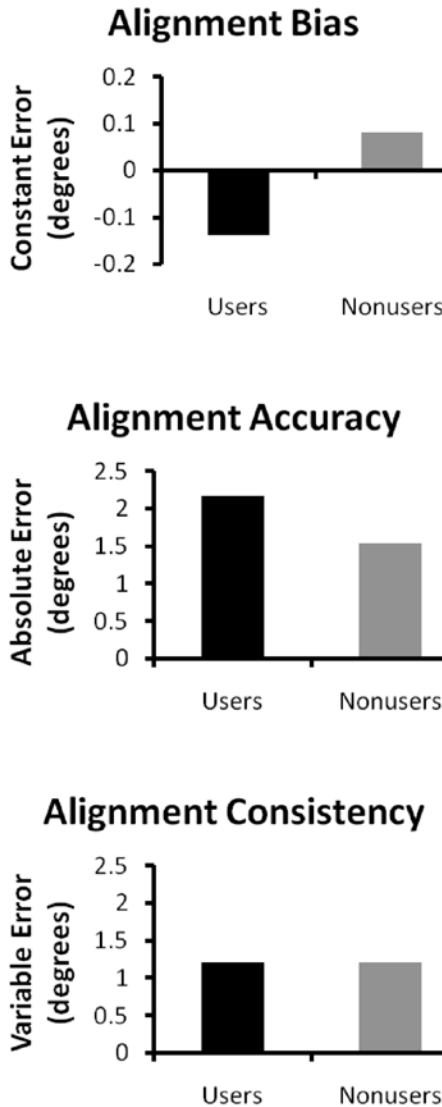


Figure 3 — Alignment errors on 4 m putts by experts who were ball line users vs nonusers.

Discussion

Van Lier et al. (2011) found that standing closer to the ball while keeping the head positioned horizontal and directly above the ball aids players in reducing perceptual error. Experts in our study followed this putting setup but not novices who tended

to stand further from the ball with their head positioned well above horizontal. Not surprisingly, experts putted more accurately and consistently than novices, but unlike results of the Johnston et al. (2003) study, novices did not show any sign of putting bias particularly to the right of target. Nearly all the putting biases measured from putter head at address and impact, and putter path were within 1 degree regardless of the length of putt or use of ball line. The absence of main effects for length of putt and ball line, and interactions between skill, length, and ball line, indicate that using the ball line does not aid in reducing putting bias and does not impact one group or one length of putt more than the other.

The aim of putter path through impact was different from the aim of putter head at address and at impact in all three putting error scores. Putter path tended to aim slightly more left of target than putter head aim at address and at impact. Putter path also was less accurate and less consistent than the two other aims. The aim of the path of putter not coinciding with the aim of putter head is an indication that there was unnecessary sagittal plane movement of flexion and extension at joints, particularly the shoulder. It is common among novices to cut the ball where the path of putter head is to the left of the aim of putter head. This type of putting stroke is caused by flexing the arms at the shoulders on the backswing and extending them on the forward swing. Because the putter path is to the left of the aim of putter head at impact, the ball will travel in the direction of the putter aim but with some sidespin.

Overall, results indicate that use of ball line does not significantly aid putting alignment. Therefore, it is no surprise that experts in the study who typically use ball line in competition did not perform putts better than nonusers. It is interesting, however, to find that the ball line users struggled to align the ball line to the target and that they were not more accurate than nonusers. Perhaps, this inability to align the ball accurately to the target line might explain why ball line users did not putt more accurately. Being able to see the target line directly behind the ball is an advantage because it minimizes the illusion created when trying to read the direction of the putt standing to the side of the ball. But then, trying to align a small line to the perceived target line can be a challenge. And, when a straight line is drawn on a round ball, any slight tilt of the ball to the side can make the line appear crooked when viewing from the top, thus difficult to align.

If the ball line does not aid in putting, why are so many players using it? Could it be more mental effect, giving players another reference line to rely on and thus increase levels of confidence? A player mentioned that he uses it only as a reference of general target line but does not trust the line completely when putting. Some players say they use it only during practice and others have quit using ball line because they felt the aligned ball line and the perceived target line when getting setup to putt did not coincide. Thus, it was more confusing because they could not decide which line to trust.

In this study, players were asked to align the ball line to the target line. Because it was a straight level putt, players had a virtual target at which to aim. However, players will more often face breaking putts than straight putts during a round of golf. Therefore, first, they must aim at an imaginary target; second, they must place the ball line along the perceived target line; and third, they must place the putter square to the ball line both at address and at impact. These steps may be too much for some players to handle, making it difficult to establish a consistent

pattern between the initial perceptual aim and the actual putter aim due to the additional task of adjusting the ball line. Misreading the correct line of a putt may not be as critical as long as the putter is consistently aiming to the correct line of putt. Keeping the task simpler will facilitate developing a more consistent pattern between aim and putt.

In conclusion, it appears that using a ball line does not aid in aligning a straight putt. We did not test the effect of ball line on a breaking putt due to the difficulty of measuring the true line of a putt which will vary depending on ball speed. We also did not record the putts made because the putter can be aligned accurately but with lack of speed, the ball will stop short. We focused on where the putter was aimed and not how hard the ball was struck since ball line is assumed to affect only direction. Therefore, though we speculate that the use of ball line would complicate the alignment more with breaking putts, we do not have evidence to either support or argue against use of the ball line on breaking putts. One other note, despite our effort to mimic a natural setting, participants had to wear goggles and putt on an artificial grass surface. While putting on an artificial grass surface may not hinder performance, wearing goggles may have produced discomfort and, losing vision after impact or the anticipation of losing vision after impact may have had some effect on participants.

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