

Gaze Behaviors of Elite Golfers: Does Task Difficulty Influence Quiet Eye?

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Purpose

Improving putting performance is of significant interest to elite golfers and coaches as the potential for performance gains and lucrative financial rewards are high (Hellstrom, 2009). A critical element of golf putting is visual gaze control, specifically the Quiet Eye period (QE), the final fixation on a target before action execution (Vickers, 2007). QE has been found to be a predictor of expertise in a range of aiming sports such as, golf, basketball, shooting with experts having a longer duration of QE and earlier onset of QE (see Mann et al., 2007; Vickers, 2009 for reviews). To date, researchers examining visual gaze in golf putting have tended to use laboratory-based tasks focusing on relatively short, straight putts. The primary aim of this study was to examine QE in elite golfers using a more representative putting task in which task difficulty was systematically manipulated by both the length and lateral slope of the putts.

Method

Participants were twenty-two experienced golfers (18 males and 4 females aged between 17 years and 78 years) including 15 amateurs (handicaps ranging from -2 to +5) and 7 professionals. Participants were assigned to More Successful (MS) or Less Successful (LS) groups by using the median split technique using the within-task criterion of the number of putts holed at 8ft and 15ft distances on the task outlined below. Participants completed a representative putting task on an indoor artificial surface, which had a STIMP rating of 10.2. Task difficulty was manipulated through varying the distance (3ft, 8ft, 15ft, 25ft) and lateral slope of the putt (slope, no slope). Participants completed 16 putts at each distance, comprising eight straight and eight sloped putts (four R-L putts and four L-R putts), giving 64 putts in total; incompletely counterbalanced across participants. Participants were given forty seconds to complete each putt and asked to carry out their normal putting routines. Visual search behavior was captured using the ASL Mobile Eye XG Mobile Eye Tracker. Performance was assessed by recording the number of putts holed and by calculating absolute error: the distance from final resting position of the ball to the hole (cm).

Analysis/Results

Quiet Eye. QE was analysed using a 4 (Distance) x 2 Putt Type (Slope/No slope) x 2 (Success Rate) mixed-factor ANOVA, with distance and slope entered as within-participant factors. The analysis revealed a significant main effect for slope, Wilks' Lambda=.72 $F(1,16)=6.05$ $p=.026$, see Figure 1. This reflected longer QE duration for straight putts than for sloped putts, which was contrary to expectations. All other main effects and interactions were non-significant, thus, there was no difference in QE between the MS and LS counterparts.

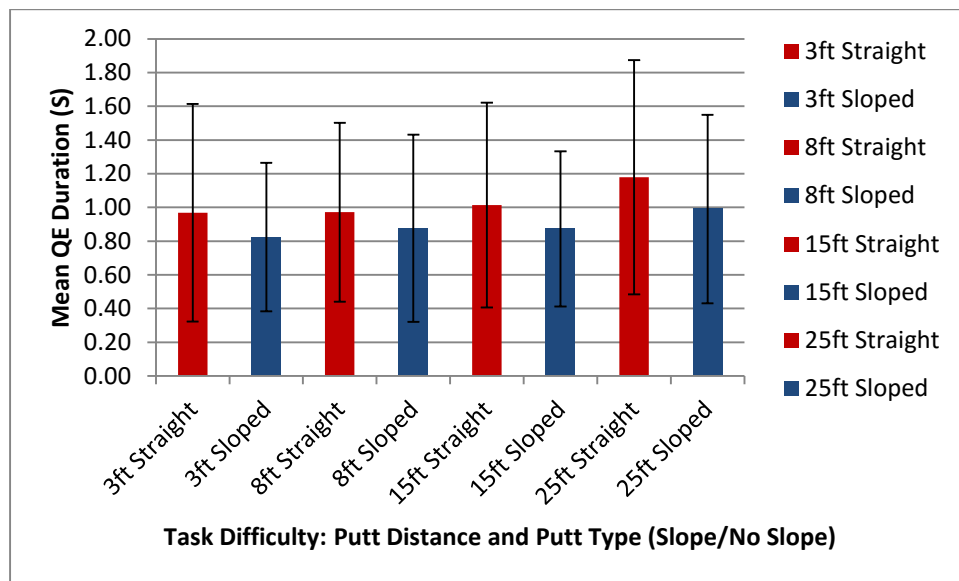


Figure 1: Mean QE duration for sloped and straight putts across 3ft, 8ft, 15ft, 25ft distances.

Performance. Performance (putts holed) was analyzed using a 4 (Distance) x 2 (Putt Type) x 4 (Putt Number) x 2 (Success Rate) repeated measures ANOVA. Analysis revealed significant main effects for success rate, $F(1,20)=22.64$, $p<.01$, putt distance, Wilks' Lambda =.01, $F(3,18)=543.33$, $p<.01$, putt type, Wilks' Lambda =.47 $F(3,18) = 6.77$ $p<.01$. There was also a significant interaction for success rate by distance, Wilks' Lambda =.37, $F(3,18)=10.13$, $p<.01$. There were non-significant effects for putt number Wilks' Lambda = .808, $F(3,18) = 1.421$, $p = .269$ and the 4 (Putt Number) x 2 (Success Rate) interaction, Wilks' Lambda = .964, $F(3,18) = .224$, $p = .88$, suggesting there were no practice effects. Performance

(absolute error, distance from the hole) was analyzed using a 4 (Putt Distance) x 2 (Putt Type) x 2 (Success Rate) repeated measures ANOVA. There was a main effect for putt distance, Wilks' Lambda = .064, $F(3,18) = 87.36$, $p < .01$, the other main effects and interactions were non-significant.

Independent sample t-test explored the differences in Success Rate (putts holed) and putt type (slope/no slope) and putt numbers between MS and LS golfers (see Table 1 for the significant differences between MS and LS golfers).

Trial	<i>p</i> Value	Effect Size
8ft R-L Putt 1	$p = 0.008$	0.5
15ft Straight Putt 5	$p = 0.001$	0.67
15ft Straight Putt 7	$p = .024$	0.8
15ft R-L Putt 3	$p = .007$	0.6
15ft L-R Putt 1	$p = .016$	0.5
15ft L-R Putt 4	$p = .016$	0.5
25ft R-L Putt 3	$p = .038$	0.6

Table 1. Putt Type (Slope/No Slope) with significant differences between more successful and less successful golfers

Conclusions

A more ecologically valid task, compared to previous laboratory-based protocols, was designed to represent better the perceptual-cognitive demands of high-performance golf putting. The data revealed considerable within-participant variability in both QE and performance measures. The within variability of participants in putts holed and QE highlight that within experienced amateur and professional golfers there is inconsistency within their putting accuracy and their routines. There was between-participant variability in putts holed but not in error distance. Contrary to our predictions, we found QE to be longer for straight putts than for sloped putts, particularly in the longer putt distances of 8ft, 15ft, and 25ft. We further note that planning time was not measured in this study and this may influence QE duration.

Further research is also required to help understand the mechanisms underlying QE and their relationship with successful golf putting.

Keywords [Quiet Eye, Putting, Perceptual-Cognitive, Elite]

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Biography

Laura Carey works at the sportscotland institute of sport as a Performance Psychologist and is a doctoral student at Loughborough University. The study was conducted as part of the lead author's doctoral research under the supervision of Dr Robin Jackson, Dr Malcolm Fairweather, Dr Joe Causer and Professor Mark Williams.