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# A 'New' Old Course? An Assessment of the Effects of Alterations to the Old Course at St. Andrews on the 2015 Open Championship

Charles E. Gaudet*
*Department of Psychology, University of Rhode Island, Kingston, RI, USA*

**Abstract**. The Old Course at St. Andrews Links is one of the world's most revered golf courses and the Open Championship is the oldest major championship in professional golf. In 2015 the Old Course hosted the Open Championship. Beforehand, several of the course's holes were altered in an attempt to maintain its difficulty and counteract the rapid advances in professional golfers' skills and equipment. This study assessed the effects of the alterations to the Old Course in two ways. The aggregate performance statistics for the 2005, 2010, and 2015 Open Championship tournaments, all hosted at the Old Course, were compared. Scoring on the altered holes was compared across the 2010 and 2015 tournaments, as were the differences between the altered and unaltered holes. The analyses took into account the weather conditions. Players' overall scores *improved* between the 2010 and 2015 tournaments, but not between the 2005 and 2010 tournaments. Players' scores only differed between the 2010 and 2015 tournaments for two of the altered holes, indicating that the changes had a negligible overall effect. Strategic factors that might account for the observed differences and the implications of the analysis for efforts to alter courses to maintain difficulty are discussed.

Keywords: Golf, St. Andrews, Open Championship, course alterations

## 1. Introduction

The Open Championship is the oldest of golf's four major championships (the Masters, the United States Open Championship, the Open Championship and the Professional Golf Association Championship (PGA) Championship). Since its inception in 1860, 14 different golf courses located throughout Scotland, England, and Northern Ireland have hosted the Open Championship. The Old Course at St. Andrews Links has served as the site of the Open Championship on 29 occasions, and since 1873, it has hosted the tournament at least once per decade. Since 1990, the tournament has returned to the Old Course every 5 years (1990, 1995, 2000, 2005, 2010 and 2015) (Jarrett & Mason, 2012). The Old Course is not regarded as the most challenging of the courses to host the Open Championship, but it may be the most prestigious. Jack Nicklaus, three-time Open Champion, including twice at the Old Course (1970 and 1978), noted, "if a golfer is to be remembered he must win the Open at St. Andrews" (Jarrett & Mason, 2012, p. 185). The Old Course is noted for its unique, historic features such as the finishing hole that is overlooked by the Royal and Ancient (R&A) Clubhouse and the houses along Links Road and Golf Place, the infamous Valley of Sin protecting the green's front, and the Swilcan Bridge that carries players over the Swilcan Burn which runs through the fairways of the 1st and 18th holes.

*Corresponding author: Charles E. Gaudet, Department of Psychology, University of Rhode Island, 142 Flagg Road, Kingston, RI 02881, USA. Tel.: +1 401 874 2193; E-mail: chad_gaudet@my.uri.edu.

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The Old Course relies on both its design and the effects of the natural elements, such as wind and rain, to challenge golfers. The most readily identifiable manmade features of the course are probably the 112 bunkers, or sand traps (EuropeanTour.com, 2014). The Old Course's bunkers are strategically designed and placed throughout the course so as to influence players' shot selection. They achieve this by producing treacherous lies for players whose shots find them and thus imposing severe penalties for doing so. The 'Coffins', a group of three bunkers situated approximately 300 yards from the tournament tee on the 13th hole are intended to pose a risk-reward choice for players when they select their club and strategy for the tee shot. European Tour commentator, Ken Brown has noted, "You have a decision off the 13th tee as to which side of the Coffin bunkers you are going to take . . . The killer about them is that they are exactly where you want your tee shot to go so it makes it very strategic, very tactical" (EuropeanTour.com, 2014). If a player elects to hit a drive and successfully avoids the Coffins he is rewarded with a prime position for an approach shot to the green; conversely, if the player's ball lands in one of the bunkers, he is faced with an approach shot that is much more daunting and significantly lowers his odds of making par for the hole.

The Old Course's bunkers are inextricably woven into the history of the Open Championship as well. The Road bunker, located on the infamous 17th hole ('Road Hole'), forms a boundary to the left side of the green, complemented by the stone wall bordering the road running alongside the right side of the green. These hazards combine to severely threaten players' hopes of making par should a wayward approach shot land in the bunker or on the road (Jarrett & Mason, 2012). During the third round of the 1978 Open Championship, Tsuneyuki Nakajima, then in third place, took four shots to hit his ball out of the Road bunker, effectively extinguishing his chances of winning the tournament (EuropeanTour.com, 2014). The Road bunker has been altered many times during its history. And for the 2015 Open Championship, its right-hand side was widened by half-a-meter (Passov, 2015).

What is perhaps the Old Course's most infamous bunker, 'Hell', awaits players' second shots on the Par 5 14th hole. Hell measures 300 square meters, is three meters deep and has an approximately four-and-a-half-meter front lip (EuropeanTour.com, 2014). Even if a player successfully dodges Hell there are several smaller pot bunkers such as Devil's Kitchen and Graves close by on the 14th fairway (Jarrett & Mason, 2012). Tiger Woods's extreme aversion to the Old Course's bunkers drove him to employ a strategy for the 2000 Open Championship at St. Andrews that consisted of avoiding the bunkers at all costs. Woods successfully executed the strategy, avoiding the bunkers across all four rounds of the tournament and achieving a score of -19, resulting in an eight-shot victory (EuropeanTour.com, 2014). One major factor in Woods's ability to avoid the bunkers was his club selection; he elected not to hit his driver, opting instead for clubs that provided greater accuracy. The strategic placement of penal bunkers throughout the Old Course increases the pressure on players to effectively analyze costs and benefits as they navigate the course from shot to shot. For the 2015 Open Championship, and as part of planned course alterations, additional bunkers were added to the course for the first time since 1949 (Whitten, 2012).

The weather complements the challenges embedded in the design of the course. Specifically, rain and wind, sometimes operating independently and sometimes in conjunction, can markedly influence the effectiveness of a given player's skillset. It often rains during the Open Championship as it is held in July. The effects of rain on golf are nuanced. It may directly affect a player's grip on his club, or in extreme conditions, his vision. Its indirect effects via the course are far-reaching. On the firm fairways of links courses such as the Old Course, rain can neutralize the speed with which the ball runs along the fairway. This may restrict the total distance the golf ball travels on any given shot; however, it may also afford the player additional control over his shot as the ball is more likely to remain close to its landing place. Rain also affects the conditions of the green, or putting surface. The accumulation of sufficient rain will soften the putting surface, resulting in slower putts and increasing the likelihood that an approach shot that lands on a green remains on a green rather than rolling off, as it might in drier conditions. Wind can also wreak havoc with a player's performance. The Old Course's location on the Scottish coast makes it particularly susceptible to strong, unpredictable winds. Most notably, wind affects the flight of a player's shot; it can alter both its direction and distance. The strength of the wind is certainly one of the main variables players need to take into account; however, the unpredictability of the wind interacts with the embedded hazards of the course, such as its undulations and bunkers, to amplify its difficulty. Throughout the course the wind speeds and directions can shift balls that would

otherwise have been on target into unfavorable positions, even into the bunkers. A notable example from recent history occurred during the 2010 Open Championship at the Old Course. During the first round of the tournament, in relatively favorable conditions, Rory McIlroy shot the lowest opening round score in Open Championship history (63) (Jarrett & Mason, 2012). However, during the second round of the tournament, when the wind gusted up to 29 miles per hour (MPH) and 0.16 inches (in.) of rain fell (Wunderground.com, n.d.), McIlroy recorded a score of 80 (Jarrett & Mason, 2012). Of these two features that strongly influence player performance, course design and conditions, only the design can be altered.

In November 2012 the St. Andrews Link Trust announced that it was planning alterations to nine of the 18 holes of the Old Course. According to the then chief executive of the R&A, Peter Dawson, the changes were intended to increase the difficulty of the course to match the improvements in professional golfers' skills (see Reid, 2012; Whitten, 2012). The timing of the changes coincided with the Open Championship, which returned to the Old Course in 2015; however, the impetus for these changes was likely to have come from the rapid technological advances in golf equipment that have helped players to overcome the punitive features embedded in the original designs of many golf courses.

Golfers' equipment has evolved rapidly in recent years; one of the most prominent byproducts of the technological evolution has been significant gains in distance, or how far a player can hit the ball (Mendik, 2007). In 1992, the average driving distance on the PGA Tour was 260.4 yards; by 2003, that figure had risen to 286.4 yards. Research conducted by Heiny (2008) indicated that this gain in distance was not attributable to younger and stronger players joining the tour; the more likely cause was the increase in the size of driver heads, which ranged from 245 cc to 285 cc in 1995 but had expanded to between 365 cc and 400 cc in 2000. This structural advance, in conjunction with the replacement of wound ball technology with innovative solid-core ball technology, appears to have been the main factor behind the substantial increase in driving distance (Heiny, 2008). In 2015 Dustin Johnson led the PGA Tour in average driving distance, with an average of 317.7 yards and David Toms was in last place, with an average driving distance of 270.0 yards, still approximately 10 yards greater than the 1992 average for the PGA Tour (PGATour.com, n.d.).

The governing bodies of golf have not remained idle during this period of rapid technological advancement. One strategy for keeping pace with technological advances has been to adapt the rules governing the sport and some of the more significant rule changes are described below. In 1974, the R&A allowed the use of a smaller ball, 1.62 in. in diameter, in the Open Championship (1.68 in. in diameter is the current standard), which has obvious advantages given that it must be rolled into a cup measuring 4.25 in. in diameter (Myers, n.d.). In addition, prior to the 2010 season, clubs containing U-shaped grooves designed to put more spin on the golf ball and promote greater accuracy were banned. A study of the effectiveness of this rule change concluded that players successfully offset the rule change by changing their strategy, and that golfers' performance (measured as number of strokes to complete a hole) actually improved following the ban (McFall & Treme, 2012). The most recent significant rule change will prohibit golfers from anchoring putters to their body to improve the stability of a putt; this change came into effect at the beginning of the 2016 season (Myers, n.d.).

A complementary approach to offsetting technological advances involves altering the design of existing golf courses. Perhaps the most publicized course alterations to date occurred at Augusta National Golf Course, the site of the Masters tournament. Following Tiger Woods's 12-stroke victory at the 1997 tournament, the course underwent a variety of changes designed to neutralize the advantages of Tiger Woods's ability to drive the ball long distances. Course designer Tom Fazio added length to many of the holes, and trees were added to reduce the potential angles for shots; the rough was allowed to grow higher and the fairway was narrowed. Tiger Woods commented on how these changes affected his club selection in subsequent Masters tournaments, "As you say in '97, I hit driver, wedge twice into 15 . . . That year I hit wedge, wedge, 8-iron, 4-iron. That's a big change. Now you're hitting a wood or some kind of hybrid or long iron, maybe, into 15" (Harig, 2011). Woods's comments illustrate how the changes at Augusta National forced him to select longer, less accurate clubs for approach shots on hole 15, rather than the shorter, more accurate clubs on which he had been able to rely prior to the changes.

The trend for course alterations has persisted. In 2011, in advance of the 2014 U.S. Open, Pinehurst No. 2 was restored so as to reflect the original design by famous course architect Donald Ross more

accurately, whilst also increasing its length from 7,214 to 7,565 yards (Pinehurst.com, n.d.). The 2022 U.S. Open is scheduled to be played at the Country Club in Brookline, Massachusetts. The Country Club, which last hosted a U.S. Open in 1988, lengthened the course from 7,010 yards in 1988, to 7,380 yards in advance of the 2013 U.S. Amateur Championship. The resulting scores during the 2013 U.S. Amateur Championship – an average score of 76.4, with only six out of 312 rounds resulting in a score less than 70 – may have contributed to the United States Golf Association (USGA)'s decision to select the Country Club as the site for its major tournament having not held the event there in more than 20 years (Whitmer, 2015). Royal Troon in Scotland, selected as the site of the 2016 Open Championship and host for the first time since 2004, underwent a number of architectural changes in advance of the tournament. Like the changes made to the Old Course before the 2015 Open Championship, many involve adding or moving bunkers (Dudley, 2013). It appears that course alterations are perceived as an essential tool in the adaptation of courses to cope with the modern game.

The Old Course is not impervious to change (Whitten, 2012). In a sense, the Old Course pioneered the idea of changes to the layout of golf courses. In 1764 the standard round of golf, which had previously consisted of 22 holes, was deemed to consist of 18. Around the same time the innovative 'double putting green', which allowed for speedier play, was introduced (Jarrett & Mason, 2012). In the 1990s the bunkers of the Old Course were deepened, adding a degree of difficulty for golfers attempting to hit their balls out of them (Whitten, 2012). More recently, in advance of the 2010 Open Championship at the Old Course, a new back tee was added to the 17th hole to lengthen it by 35 yards (Passov, 2014). The most recent changes, made in advance of the 2015 Open Championship, involved alterations to nine of the 18 holes although none of the holes underwent a substantial change in length. The changes consisted primarily of replacing or adding bunkers throughout the course and subtle changes to green and fairway contours. More so than in the past, it appears that in recent years the stimulus for changes has been a desire to increase the course's difficulty. In contrast to changes made to other courses that have centered largely on lengthening the holes to minimize the benefits of modern players' raw power, the most recent round of changes at the Old Course was seemingly intended to enhance the inherent psychological challenges of the course through the addition of intimidating, strategically placed bunkers and slight changes to the contours of several greens and fairways. These changes were met with criticism by the mainstream media. The British Broadcasting Company (BBC) golf correspondent, Iain Carter, commented on changes to the Old Course by likening golf to marathon running, "The sport is about who makes the lowest score. You don't extend a marathon course or dig some potholes to make it more challenging because today's runners complete it too quickly" (Carter, 2012). Golf architect Tom Doak even attempted to organize a petition amongst his fellow architects bemoaning changes to the course (Whitten, 2012).

Over the past twenty years a growing body of research into the mechanics of playing golf has accumulated. Belkin et al. (1994) identified greens in regulation as the best statistical predictor of scoring average, thus expanding the findings of Davidson and Templin (1986). More recently, Wiseman and Chatterjee (2006) replicated earlier findings on the importance of shot-making skills. The associations between golfers' performance statistics have been investigated in correlational studies (Quinn, 2006). In 2002 Ketzscher and Ringrose questioned the predictive utility of performance statistics in assessing player performance and called for more advanced measures. There is a body of research on associations between player performance and earnings (Callan & Thomas, 2007; Ehrenberg & Bognanno, 1990; Holder & Nevill, 1997). Sachau et al. (2009) conducted a three-part psychometric study whose aim was to assess the validity of golf tournaments as a measure of golfers' competence. McFall and Treme (2012) investigated the effects of the ban on U-shaped grooves on player performance. This expanding body of golf research does not, however, include a quantitative assessment of the effects of golf course alterations.

The purpose of this study was to assess the effects of the changes made to the Old Course at St. Andrews in advance of the 2015 Open Championship. The alterations were intended to augment the preexisting challenges of the Old Course and one might, therefore, expect to see worse (i.e., higher) score at the 2015 Open Championship; other performance metrics such as driving yardage, driving accuracy, greens in regulation, and number of putts might also be affected by the changes. This study appears to be the first to attempt to quantify the effects of course alterations on players' strategy and performance in a major tournament. It provides preliminary insight into whether changes to the world's oldest golf course

have affected players' strategy and performance on the course.

## 2. Course alterations

The St. Andrews Link Trust hired golf architect Martin Hawtree to design changes to the Old Course in advance of the 2015 Open Championship (Whitten, 2012). The alterations made to the Old Course are detailed below; the data on par and length are based on the 2015 Open Championship (Passov, 2015; Graylyn Loomis, 2012). The total length of the course for the 2015 Open Championship was 7,297 yards.

*Hole 2*: 'Dyke' Par 4, 452 yards. Two bunkers located to the front right of the green were moved closer to the green, reducing the landing area between the bunkers and the green. This change restricted the landing area for approach shots, thus placing a premium on the player's ability to control his shot into the green.

*Hole 3*: 'Cartgate (out)' Par 4, 398 yards. The first fairway bunker located along the right side of the fairway was moved approximately 50 yards further from the tee box. This change brought the bunker closer to the likely landing area for tee shots, thus adding to the importance of achieving an accurate tee shot.

*Hole 4*: 'Ginger Beer' Par 4, 480 yards. Two bunkers located to the front right of the green were filled, and one larger bunker was moved closer to the front right edge of the green. The ground occupying the front area of the green was re-contoured. These alterations restricted the landing area for approach shots as well as adding new contours that affect chip shots and putts to the front of the green.

*Hole 6*: 'Heathery' Par 4, 414 yards. The front right portion of the green was re-contoured. Specifically, it appears that the front portion of the green was raised in an attempt to make it more difficult for players to use its slope to check approach shots.

*Hole 7*: 'High (Out)' Par 4, 371 yards. A large sunken area in the fairway was filled, creating a slight mound. The anticipated effects of this change were minimal.

*Hole 9*: 'End' Par 4, 352 yards. A large bunker was added approximately 50–60 yards short of the green to the left of the fairway. This narrowed the landing area within the fairway as there are two bunkers situated on the right side of the fairway directly opposite the new bunker.

*Hole 11*: 'High (In)' Par 3, 174 yards. The back left portion of the green was lowered and flattened to create more pin positions. This change allowed for a greater variety of challenging pin locations.

*Hole 15*: 'Cartgate (In)' Par 4, 455 yards. The ground on the back portion of the green was re-contoured to create more undulations. This change was likely intended, depending on the hole location, to make putts more challenging, as well as creating more challenging chip shots for players who hit their approach shot over the green.

*Hole 17*: 'Road' Par 4, 495 yards. The right side of the road bunker was widened by 0.5 meters, and a small portion of the front of the green was re-contoured. The effects of these changes were expected to be minimal. The road bunker, which is situated slightly to the front left of the green (as viewed from the fairway), may capture more wayward approach shots as a result of its slight expansion, thus the changes may make approach shots on this hole slightly more difficult.

## 3. Data and methodology

Archival tournament data were retrieved from GOLFstats.com (n.d.), PGATour.com (n.d.) and TheOpen.com (n.d.). Aggregate performance statistics from the 2005, 2010, and 2015 Open Championships were collected for all the players that competed in each tournament. The inclusion of the 2005 Open Championship enabled assessment of inter-tournament changes in the absence of course changes and thus provided a control comparison; in other words, the comparison between the 2005 and 2010 Open Championships provided a context for interpreting changes between the 2010 and 2015 Open Championships. If performance statistics and scores differed widely between 2005 and 2010, it would be difficult to attribute changes between the 2010 and 2015 Open Championships to the course alterations made in the intervening period. In addition, individual scores on the altered holes (2, 3, 4, 6, 7, 9, 11, 15, & 17) and unaltered Par 4 holes (1, 10, 12, 13, 16, & 18) were collected for all rounds of the 2010 and 2015 tournaments.

Historical weather data for the Leuchars Air Base located in Leuchars, United Kingdom were collected from Wunderground.com (n.d.). According to Google Maps, Leuchars Air Base is approximately a 7.2-kilometer drive from the Old Course and is located to the northwest of it. Precipitation

(in.), average wind speed (MPH), and maximum wind speed (MPH) data were collected for the dates corresponding to the 2005, 2010, and 2015 Open Championships.[1] Alpha levels were set at 0.05 for all analyses and analyses were conducted using SPSS software, version 23.0 (Armonk, NY: IBM Corp.).

In the 2010 and 2015 Open Championships the field consisted of 156 players and in the 2005 tournament it was 155 players, as one player was disqualified. Professional golfers can secure a position in the tournament by competing in qualifying events or by earning exemptions (see TheOpen.com). Because the tournament fields were mixed, consisting of players that participated in one, two, or all three of the tournaments under investigation and interspersed with players competing in the tournament for the first, and in some cases, only time, it was necessary to assess the role of players' prior experience at the Old Course in the Open Championship.

The question of whether Open Championship experience at the Old Course accounted for a substantial amount of the variance in player performance was investigated using multivariate analysis of covariance (MANCOVA) and multivariate analysis of variance (MANOVA). The independent variable was tournament year (3 levels: 2005; 2010; 2015) and the dependent variables were strokes per round, driving accuracy, driving yardage, greens in regulation and putts per round. The number of the tournaments under consideration in which a player had competed (1, 2, or 3) was used as a covariate. This covariate was included in the model to represent experience in competing in the Open Championship at the Old Course. The results of a subsequent MANOVA without this covariate were compared with those of the MANCOVA. Specifically, the partial $\eta^2$ values were compared to determine whether the addition of the covariate accounted for a substantial proportion of variance in the data. The MANOVA yielded a partial $\eta^2 = 0.248$ and the MANCOVA yielded a partial $\eta^2 = 0.252$, suggesting that the covariate only accounted for 0.004 of the explained variance. This result suggested that prior tournament experience was not an important contributor to variance in player performance.

Two approaches were used to assess the effects of course alterations on the Open Championship: a holistic approach and micro approach. The holistic approach was based on analysis of performance statistics providing insight into player strategy. For example, statistics such as drive length and accuracy can be used to infer whether players adopted an aggressive or conservative strategy. The micro approach was based on direct assessment of the measurable impact of hole alterations on player performance.

## 4. Holistic approach: Performance statistics across tournaments

The effects of weather and conditions were considered prior to examining between-tournament differences in performance statistics. Data on precipitation (rain), average wind speed, and maximum wind speed for the 2005, 2010, and 2015 Open championships are displayed in Table 1. MANOVA with tournament year as the independent variable and precipitation, average wind speed, and maximum wind speed as dependent variables revealed that conditions were similar across the Open Championships under review, Wilks's $\lambda = 0.04$, $F(3, 8) = 59.74$, $p = 0.285$.

The performance statistics selected for this study have been shown to be strong predictors of a golfer's performance (Belkin et al., 1994; Davidson & Templin, 1986; Wiseman & Chatterjee, 2006), they were: strokes per round, driving accuracy, drive length, greens in regulation and putts per round. Strokes per round was calculated by dividing the player's total number of strokes for the tournament by the number of rounds he played (2 or 4, depending on whether he made the cut). The strokes per round variable provides a macro measure of a player's overall performance. Driving accuracy was determined by dividing the total number of fairways hit by the number of rounds played. Drive length was taken as the player's average tee shot distance, measured in yards, for tee shots on Par 4 and Par 5 holes. The greens in regulation variable is a measure of a player's efficiency in reaching the green and the criterion value is calculated by subtracting 2 from the par for each hole. For example, on a Par 4 hole, a green in regulation is counted if the player's ball lands and remains on the green or putting surface within 2 shots ($4 - 2 = 2$); for a Par 5 hole the player's third shot would need to land on the green ($5 - 2 = 3$). For this study the total number of greens in regulation hit was divided by the numbers of rounds played. Putts were also analyzed as number of putts per round.

[1] 2005 Open Championship: July 14, 15, 16, 17; 2010 Open Championship: July 15, 16, 17, 18; 2015 Open Championship – July 16, 17, 18, 19, 20 (Play was suspended on July 18, resulting in the 3rd round being moved to July 19 and the tournament being extended by one day).

Table 1
Weather conditions at the 2005, 2010, and 2015 Open Championships

| Year | Date | Round | Precipitation (in.) | Avg. wind speed (MPH) | Max. wind speed (MPH) |
|---|---|---|---|---|---|
| 2005 | 14-Jul | 1 | 0.04 | 11 | 21 |
| | 15-Jul | 2 | 0.00 | 7 | 14 |
| | 16-Jul | 3 | 0.00 | 8 | 22 |
| | 17-Jul | 4 | 0.00 | 10 | 18 |
| | Tournament Average | | 0.01 | 9.00 | 18.75 |
| 2010 | 15-Jul | 1 | 0.16 | 7 | 21 |
| | 16-Jul | 2 | 0.16 | 11 | 29 |
| | 17-Jul | 3 | 0.00 | 15 | 24 |
| | 18-Jul | 4 | 0.00 | 8 | 24 |
| | Tournament Average | | 0.08 | 10.25 | 24.50 |
| 2015 | 16-Jul | 1 | 0.00 | 8 | 20 |
| | 17-Jul | 2 | 0.35 | 18 | 29 |
| | 18-Jul | 2 | 0.08 | 24 | 34 |
| | 19-Jul | 3 | 0.12 | 5 | 12 |
| | 20-Jul | 4 | 0.04 | 7 | 15 |
| | Tournament Average | | 0.12 | 12.40 | 22.00 |

Between-tournament differences were assessed using MANCOVA with tournament year as the independent variable, player experience as a covariate and the performance statistics as the dependent variables. The MANCOVA revealed that performance statistics differed across tournaments, Pillai's Trace = 0.50, $F(12, 918) = 25.84$, $p < 0.01$, partial $\eta^2 = 0.25$. After adjusting for the effects of player experience, *post hoc* pairwise comparisons using Bonferroni adjustments revealed differences in scoring average, driving accuracy, drive length and putts per round. There were differences in two statistics between the 2005 and 2010 Open Championships. Driving accuracy improved; on average players hit 1.1 (95% CI: 0.8 – 1.5) more fairways in 2015, and drive length decreased by 10.4 yards (95% CI: –13.8 – –7.0) on average. There were differences in four statistics between the 2010 and 2015 Open Championships. Scoring average declined by 1.5 (95% CI: –2.1 – 0.9) strokes; drive length decreased by 7.2 yards (95% CI: –10.5 – –3.8); putts per round decreased by 1.1 (95% CI: –1.5 – –0.7). Means and standard deviations for the performance variables in each tournament (unadjusted for the effects of player experience) are displayed in Table 2.

## 5. Micro approach: Hole-by-hole comparisons

The micro approach involved directly assessing performance on both the holes altered in advance of the 2015 Open Championship and the unaltered Par 4 holes across all four rounds of the 2010 and 2015 tournaments. There are two scenarios which would indicate that the alterations had affected player performance. In the first scenario, players perform worse on the altered holes in the 2015 tournament than in the 2010 tournament, whilst performing similar on the unaltered holes. This scenario would imply that player performance remained relatively consistent across the two tournaments and that alterations to selected holes were responsible for a worsening in scores between 2010 and 2015. In the second scenario players perform similarly on the altered holes in both tournaments, but score better on the unaltered holes in the 2015 tournament; this would imply that the course alterations had successfully maintained the course's difficulty, offsetting improvements in players' skill and technological developments over the 5-year period between tournaments, with these gains manifest in the lower scores on the unaltered holes in the 2015 tournament.

The availability of data on weather conditions allowed these factors to be used as covariates, thus further isolating the effects of the course alterations. Two MANCOVAs were conducted with tournament year as the independent variable and precipitation, average wind speed and maximum wind speed as covariates. The scores for all rounds of all three tournaments were used as the dependent variable; the first MANCOVA analyzed scores on the altered holes (2, 3, 4, 6, 7, 9, 11, 15, & 17) and the second analyzed scores on the unaltered Par 4 holes (1, 10, 12, 13, 16, 18).

The first MANCOVA revealed between-tournament differences in scores on the altered holes, Pillai's Trace = 0.08, $F(9, 925) = 8.5$, $p < 0.01$, partial $\eta^2 = 0.08$. *Post hoc* pairwise comparisons using Bonferroni adjustments, which included

Table 2
Performance statistics at the 2005, 2010, and 2015 Open Championships

| Statistic | Tournament | Mean | Std. deviation | Differences[a] |
|---|---|---|---|---|
| Scoring average *(strokes / round)* | 2005 | 73.2 | 2.3 | 2015 < 2010 & 2005 |
| | 2010 | 73.7 | 2.4 | |
| | 2015 | 72.3 | 2.1 | |
| Driving accuracy *(fairways hit / round)* | 2005 | 10.3 | 1.3 | 2010 & 2015 > 2005 |
| | 2010 | 11.5 | 1.2 | |
| | 2015 | 11.5 | 1.1 | |
| Drive length *(yards)* | 2005 | 311.2 | 12.5 | 2015 < 2010 < 2005 |
| | 2010 | 301.0 | 12.6 | |
| | 2015 | 293.6 | 11.8 | |
| Greens in regulation | 2005 | 13.1 | 1.3 | None |
| | 2010 | 13.1 | 1.3 | |
| | 2015 | 13.3 | 1.2 | |
| Putts per round | 2005 | 32.5 | 1.4 | 2015 < 2010 & 2005 |
| | 2010 | 32.6 | 1.5 | |
| | 2015 | 31.6 | 1.4 | |

[a]Differences significant at the $p < 0.05$ level; based on means adjusted for the effects player experience.

adjustments for the effects of weather and wind conditions, revealed differences in scores for holes 2, 9, and 15. On hole 2, players' scores *decreased* by 0.17 strokes (95% CI: –0.29 – –0.05) in the 2015 tournament whereas on holes 9 and 15 players' scores *increased* by 0.24 strokes (95% CI: 0.14 – 0.34) and 0.15 strokes (95% CI 0.05 – 0.25) respectively in the 2015 tournament. Mean scores, standard deviations, and means adjusted for weather conditions in all tournaments are displayed in bold for the altered holes in Table 3.

The second MANCOVA revealed between-tournament differences in the scores on the unaltered Par 4s, Pillai's Trace = 0.07, $F(6, 928) = 10.68$, $p < 0.01$, partial $\eta^2 = 0.07$. *Post hoc* pairwise comparisons using Bonferroni adjustments, which included adjustments for the effects of weather and wind conditions, revealed differences in scores for holes 1, 10, and 18. On holes 1 and 10 players' scores *decreased* by 0.11 strokes (95% CI: –0.22 – –0.01) and 0.15 strokes (95% CI: –0.26 – –0.04) in the 2015 tournament, whereas on hole 18 players' scores *increased* by 0.30 strokes (95% CI: 0.19 – 0.41) in the 2015 tournament. Means, standard deviations, and means adjusted for weather and wind conditions in all the tournaments are also displayed for the unaltered holes in Table 3.

Table 3
Hole-by-hole average scores at the 2010 and 2015 Open Championships (altered holes in **bold**)

| Hole | Tournament Year | Mean | Std. deviation | Adj. Mean[a] | Differences[b] |
|---|---|---|---|---|---|
| 1 | 2010 | 3.97 | 0.57 | 3.96 | 2015 < 2010 |
| | 2015 | 3.85 | 0.59 | 3.85 | |
| **2** | **2010** | **4.18** | **0.69** | **4.20** | **2015 < 2010** |
| | **2015** | **4.04** | **0.63** | **4.03** | |
| **3** | **2010** | **3.91** | **0.50** | **3.92** | **No** |
| | **2015** | **3.86** | **0.55** | **3.86** | |
| **4** | **2010** | **4.25** | **0.63** | **4.21** | **No** |
| | **2015** | **4.24** | **1.93** | **4.28** | |
| **6** | **2010** | **4.07** | **0.63** | **4.05** | **No** |
| | **2015** | **3.95** | **1.95** | **4.00** | |
| **7** | **2010** | **3.94** | **0.61** | **3.90** | **No** |
| | **2015** | **3.80** | **0.52** | **3.84** | |
| **9** | **2010** | **3.71** | **0.60** | **3.64** | **2015 > 2010** |
| | **2015** | **3.81** | **0.55** | **3.88** | |
| 10 | 2010 | 4.03 | 0.60 | 3.98 | 2015 < 2010 |
| | 2015 | 3.78 | 0.65 | 3.83 | |
| **11[c]** | **2010** | **3.22** | **0.58** | **3.10** | **No** |
| | **2015** | **3.09** | **0.65** | **3.21** | |
| 12 | 2010 | 4.09 | 0.65 | 4.00 | No |
| | 2015 | 4.01 | 0.62 | 4.10 | |
| 13 | 2010 | 4.31 | 0.68 | 4.20 | No |
| | 2015 | 4.18 | 0.69 | 4.29 | |
| **15** | **2010** | **4.14** | **0.57** | **4.05** | **2015 > 2010** |
| | **2015** | **4.11** | **0.57** | **4.20** | |
| 16 | 2010 | 4.25 | 0.62 | 4.22 | No |
| | 2015 | 4.24 | 0.65 | 4.27 | |
| **17** | **2010** | **4.66** | **0.86** | **4.60** | **No** |
| | **2015** | **4.66** | **0.77** | **4.72** | |
| 18 | 2010 | 3.63 | 0.63 | 3.55 | 2015 > 2010 |
| | 2015 | 3.78 | 0.64 | 3.85 | |

[a]The adjusted means reflect the average score on the hole after accounting for the variance attributable to weather and wind conditions. [b]Differences significant at the $p < 0.05$ level; based on the adjusted means. [c]Hole 11 is a par 3; the rest of the holes displayed are Par 4s.

## 6. Discussion

The aim of this study was to assess the effects of the alterations made to the Old Course prior to the

2015 Open Championship. A holistic approach was used to examine macro-level indicators of player performance across tournaments and assess changes in performance statistics between the 2005 and 2010 Open Championships and the 2010 and 2015 Open Championships. A micro-level approach assessed between-tournament differences in scores on holes altered in advance of the 2015 Open Championship and specific unaltered holes. The analyses yielded several interesting findings that suggest that the alterations made to the Old Course had a negligible effect on scoring.

The average score in the 2015 Open Championship (72.3) was 1.4 strokes lower than in the 2010 Open Championship (73.7); this suggests that players performed better in the 2015 tournament, on the altered course. Given the stated intention of the R&A in advance of these changes, one would have anticipated comparable, if not higher, scores in the 2015 tournament. Overall, weather conditions were similar across the tournaments. There was a trend towards slightly wetter weather and higher average wind speed in the 2015 Open Championship (0.12 in.; 12.4 MPH) than in the 2010 Championship (0.08 in.; 10.3 MPH) and a trend towards a slightly higher average maximum wind speed in the 2010 Open Championship (24.5 MPH) than in the 2015 Open Championship (22.0 MPH). This analysis of weather conditions indicates that overall conditions were roughly equivalent across tournaments and were probably not the primary driver of the observed changes in scoring average across the tournaments.

The findings from the micro-analysis corroborate the holistic analysis. In these analyses, variance in weather conditions (precipitation; average wind speed; maximum wind speed) was controlled for directly, on a round-by-round basis. The analyses suggested that the alterations only increased the difficulty of two holes, nine and 15. On holes nine and 15, players' scores in the 2015 Open Championship *increased* by approximately 0.2 strokes compared with the 2010 Open Championship. In contrast, the alterations appear to have made hole two easier, as players' scores in the 2015 Open Championship *decreased* by approximately 0.2 strokes compared with the 2010 Open Championship. A similar, inconsistent pattern was observed on the unaltered holes. Scores *decreased* between tournaments on two of the holes (1 and 10) and *increased* on one hole (18). These findings do not constitute evidence that the course alterations provoked meaningful changes in player performance.

The remaining question is whether players adapted their strategy to take into account the course alterations. The holistic analysis provides some preliminary evidence that they did. Specifically, there was an almost linear decrease in average driving distance across the three tournaments, complemented by an increase in driving accuracy. In the 2005 tournament players drove the ball 311.2 yards on average, this figure decreased to 301.0 yards in the 2010 tournament, and decreased again to 293.6 yards in the 2015 tournament. In contrast, players only hit 10.3 fairways on average in the 2005 tournament, but this figure increased to 11.5 in the 2010 and 2015 tournaments. These observations suggest that players adopted Tiger Woods's strategy for the 2000 Open Championship, namely attempting to avoid all bunkers (EuropeanTour.com, 2014). One would expect such a strategy to favor the selection of clubs designed for accuracy (e.g., woods, hybrids, irons) rather than distance (e.g., driver). It appears that many of the R&A's alterations (e.g., the addition and shifting of bunkers) were designed specifically to counteract this strategy. They may have achieved a measure of success, in that players appeared less inclined to risk the accuracy of their tee shots in favor of distance; however, the additions and alterations to bunkers did not wholly offset players' gains in accuracy.

The other notable performance metric related to player skill and strategy, number of putts per round, decreased by approximately one stroke in the 2015 Open Championship (31.6) compared with the 2010 Open Championship (32.6). There are various possible explanations for this difference, some of which are related to course alterations. The number of putts per round may be influenced by the proximity of a player's approach shots to the holes. On average the player who consistently places his approach shot approximately three feet from the hole is likely to take fewer putts than the player who places his approach shot approximately 12 feet from the hole. One might have anticipated that the addition of new bunkers and the shifting of many bunkers closer to the green in order to make approach shots more difficult would lead players to adopt a more conservative strategy: accepting that their approach shots will land further from the hole in order to avoid landing in a bunker. But the data on putts per round do not support this contention. More data, such as the average distance of approach shots from the hole, in conjunction with the pin placements for each round are needed to investigate this issue further.

This study has several inherent limitations. Weather conditions at the Old Course are extremely variable and controlling for weather factors in statistical analysis is a complex issue. The weather data used in this study were aggregate or averaged data for each round of the tournament and as such, do not capture the hourly changes occurring over the course of a round. Louis Oosthuizen, winner of the 2010 Open Championship at the Old Course, remarked in regard to the course and the wind, "It's a golf course where you can have four, five, six different wind directions. You can have two, three different wind directions in one day" (Newport, 2015). Some have argued that favorable tee times, which meant that Oosthuizen played when conditions were relatively tame, were an important factor in his 2010 victory (Newport, 2015). Oosthuizen's victory illustrates the marked short-term variance in conditions at the Old Course.

The performance statistics were assessed for the three tournaments examined in the holistic analysis, but hole-by-hole data were not available for the micro analysis. Such data would have enabled further assessment of potential changes in player strategy for the altered holes. Nevertheless, the results of the holistic analyses provide strong evidence to support the study's inferences in regard to decreased driving distance and increased accuracy.

## 7. Conclusions

This analysis of the effects of alterations to the Old Course at St. Andrews on the 2015 Open Championship casts light on the ongoing struggle to balance the evolution of players' skills and technology against the enduring challenges presented by the game's most historic courses. The findings offer particular insight into how changes at the Old Course have affected this balance. First, it appears that players' skills and technology are evolving more rapidly than the course. The five-year gap between Open Championships at the Old Course cannot be overlooked. Five years is a long time in golf, particularly in the current era. Younger players, such as Jordan Speith, Rory McIlroy, and Jason Day represent a skilled generation of golfers that is physically and technologically equipped to manage the hazards presented by many of the game's most challenging golf courses, including the Old Course. It is reasonable to assume that each Open Championship played at the Old Course under the current 5-year rotation system will be contested by a more skilled field of players than the last. It follows that the incremental gains observed in the 2015 Open Championship relative to the 2010 Open Championship might have been even greater had the course not been altered; however, this study indicates that the additional gains would have been minimal as the changes to scores on the altered holes were similar to those for the unaltered holes. Maintaining average scores in the range of par for the course may represent a degree of success for the R&A in its endeavor to stiffen the course's defenses.

This study also raises several interesting directions for future research. Increases in length were a notable absence from the changes made to the Old Course. None of the alterations involved lengthening holes, which would, ostensibly, place a higher premium on distance than accuracy. The majority of alterations to other courses discussed in the introduction to this study involved significantly lengthening the courses. This raises an interesting question about the most effective method of altering a course to keep pace with technological developments and advances in players' skills. This preliminary study of the Old Course's alterations appears to suggest that simply shifting and adding bunkers is insufficient, if the goal is to curb the number of low scores. However, further inquiry is required to obtain a full understanding of how the lengthening of courses is affecting player performance. Since the famous 'Tiger-proofing' of Augusta National in the early 2000s, the tournament has been won by a mixture of players, both those known as long hitters such as Tiger Woods, Phil Michelson and Angel Cabrera and shorter hitters such as Mike Weir and Zach Johnson (Harig, 2011). It is likely that there are optimal and efficient ways to alter golf courses whilst preserving their playability and unique heritage; however, to date, a 'one size fits all' formula has not been discovered.

The overarching conclusion of this study is that there are limits to the capacity of the R&A, or any other governing body, to enhance a course's difficulty in order to offset player and technological advances. In the case of the Old Course, the forces that appear most suited to achieving this, namely the weather conditions, are beyond the control of the R&A. According to five-time Open champion Tom Watson, "When you have that type of wind, equipment doesn't help you a whole hell of a lot" (Newport, 2015). Although assessing the effects of weather conditions was not the central aim of this study, an illustration follows. During the second round of the 2010 Open Championship when the wind speed aver-

aged 11 MPH and gusted up to 29 MPH, players took approximately 1.6 strokes more to complete the nine altered holes than in the fourth round of the same tournament, when the average wind speed was only eight MPH and the gusts only reached 24 MPH. The location of the Old Course, on the Scottish coast, ensures that its unpredictable weather will continue to be a factor in efforts to preserve the historic challenge of the Old Course.

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