USGA Green Section

Golfers' Decision Making on the Golf Course

Data Analysis Report

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INTRODUCTION: GOLFER DECISION MAKING ON THE COURSE

The United States Golf Association (USGA) collected survey data from 2,263 golfers to investigate their on-course decision making. The survey consisted of 18 questions that retrospectively probed golfers' considerations when making decisions about tee shot strategy, approach shots and putting.

The survey gave participants an option to provide demographic information. Eighty-three percent of the sample provided it. Of those who answered demographic questions, 1,740 were male (76.9%) and 139 were female (6.1%). The remainder of participants did not answer the demographic questions. In the U.S., females make up approximately 24% of the golf population (National Golf Foundation, 2020) – which means that female golfers were underrepresented in this study.

In the following report, nine research questions are answered. These analyses provide insight into golfers' decision making. Findings in the report are described as significant when the *p*-value of an analysis is less than 0.05. A *p*-value less than 0.05 indicates there is less than a 5% probability that the differences found are because of chance. When relevant, the report will also discuss the findings in the context of existing literature that investigated similar decision-making strategies of golfers.

SECTION 1: GOLFERS' RECALL OF A SPECIFIC ROUND ON A SPECIFIC COURSE

Description of golfers and their golf experience

In the first section of the study, golfers were asked to, *"Describe the course you last played and the one you will recall when answering the questions?"* Seventy-six percent of golfers recalled playing on a course on which they had familiarity. Twelve percent recalled a course that they were somewhat familiar with. Less than 7% of participants recalled playing on unfamiliar courses, and less than 1% of participants indicated a course other than the options given.

Participating golfers were then asked about the purpose of the round they recalled when answering the survey questions, and whether the specific hole they

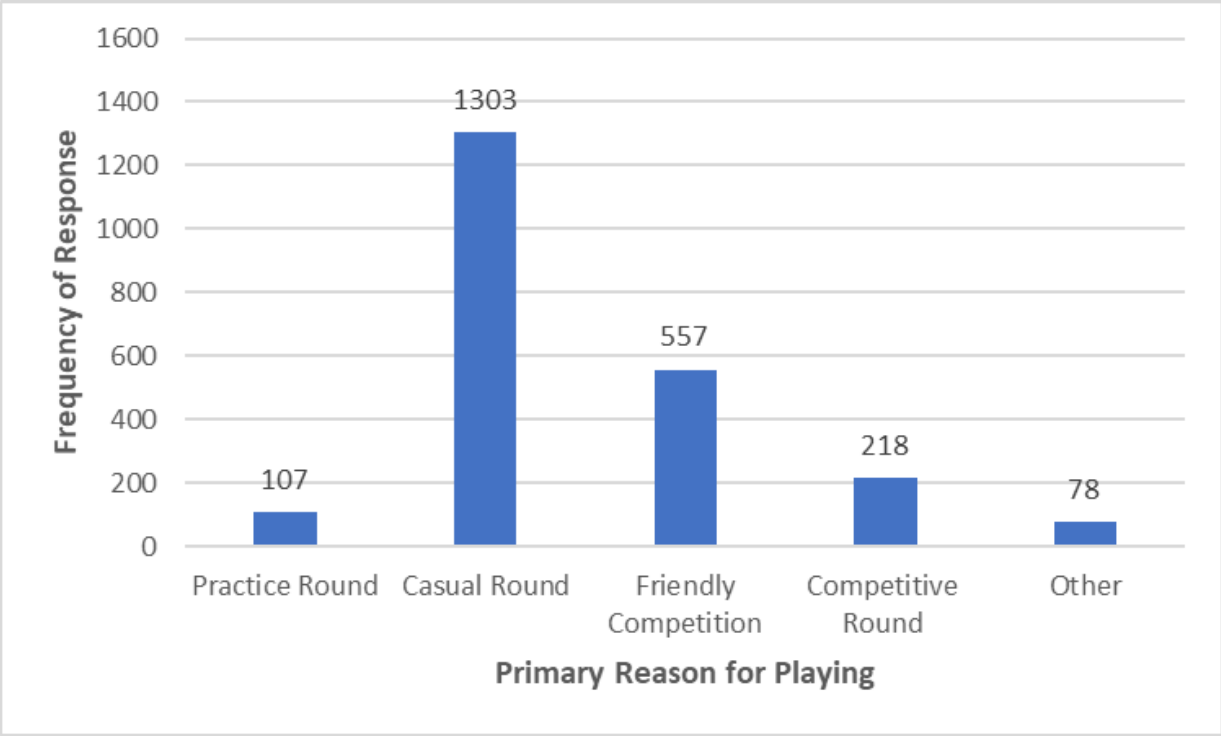
chose was a par four (52.4%) or par five (47.5%). Most participants (57.6%) recalled a casual round they played for enjoyment (Figure 1).

When reporting golfers' decision making on the course, the three categories of gender, golf course type and reason for playing were folded together unless significant differences were found between groups – in which case data were reported by group. Data for par fours and par fives are reported separately.

Female golfers in the current study reported an average driving distance of 177.4 yards (Standard Deviation (*SD)* = 28.48). They had a Handicap Index® of 18.1 (*SD* = 8.79) and on average, scored 93.03 (*SD* = 10.32) for 18 holes of play. The USGA (2021) reports that a female's average handicap is 27.5. Based on these data, female golfers participating in this survey had a lower handicap and drove the ball farther than typical female golfers (Arccos, 2020). Males in the study reported an average driving distance of 228.3 yards (*SD* = 28.04). They had a Handicap Index of 12.98 (*SD* = 6.31) and on average, scored 85.96 (*SD* = 6.95) for 18 holes of play. This driving distance (Arccos, 2020) and handicap average is relatively consistent with the norm for male golfers in the U.S. (USGA, 2021).

In relation to other players, both male and female golfers were likely to describe themselves as having about the same level of accuracy as their playing partners (M = 45.3%, W = 48.9%). Thirty-eight percent of males and 33% of females described themselves as more accurate than their playing partners. Males were less likely than females to describe themselves as much more accurate than their playing partners (M = 9.4%, W = 13.9%). And females were less likely than males to describe themselves as much less accurate than their playing partners (M = 6.7%, W = 3.6%)

Figure 1: Type of Round Golfers Used in Study Section 1



Research Question 1: How difficult was it to reach the green in regulation (GIR)?

Golfers responded to the question, "*How difficult was it to reach the green in regulation (GIR)?*" on a 4-point continuum scale (1 = too long for my hitting distance, 4 = easily reachable). On par fours, male golfers (Maximum Likelihood (ML) = 2.67, *SD* = .91) were significantly more likely to say that they were able to reach the green in regulation than female golfers (*ML* = 1.94 *SD* = .96), *t statistic (t)* (51) = 6.34, $p < .01$. The difference between reachability for male and female golfers on a par five was smaller but remained significant. Males (*ML* = 2.70, *SD* = 1.05) were significantly more likely to report that they were able to reach the green in regulation than females (*ML* = 2.20 *SD* = .92), $t(51) = 4.33$, $p < .01$. (Figures 2 – 5).

Both male and female golfers reported that par-five holes were more reachable than par-four holes. However, this difference between the reachability

of par fours and par fives did not reach a level of significance for either male or female golfers.

Figure 2: Reachability of Par 4s in Regulation (Male Golfers)

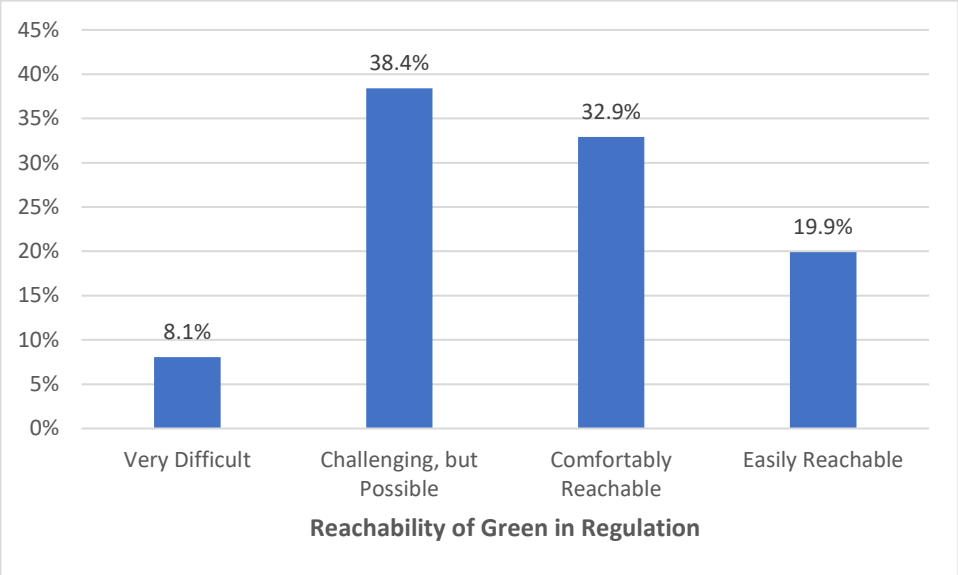


Figure 3: Reachability of Par 4s in Regulation (Female Golfers)

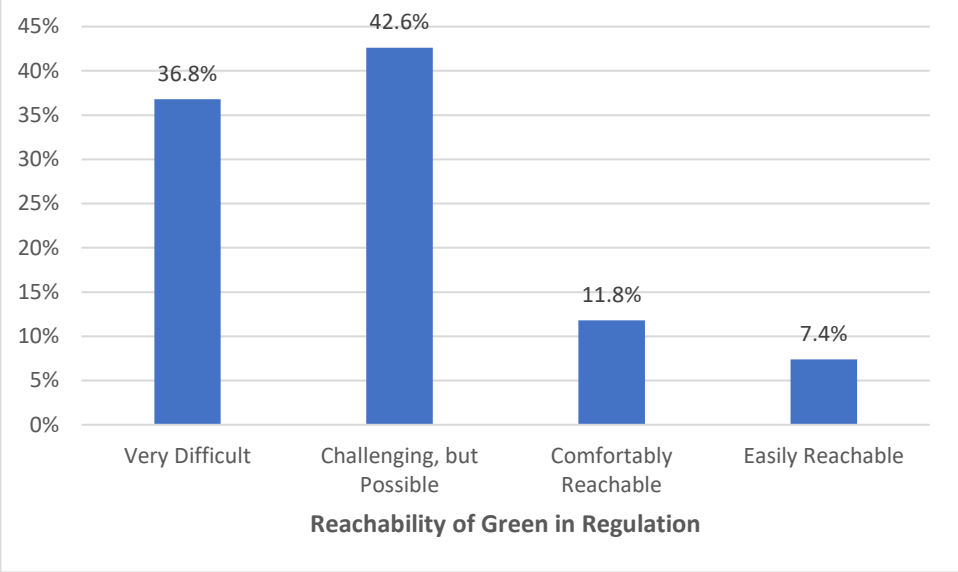


Figure 4: Reachability of Par 5s in Regulation (Male Golfers)

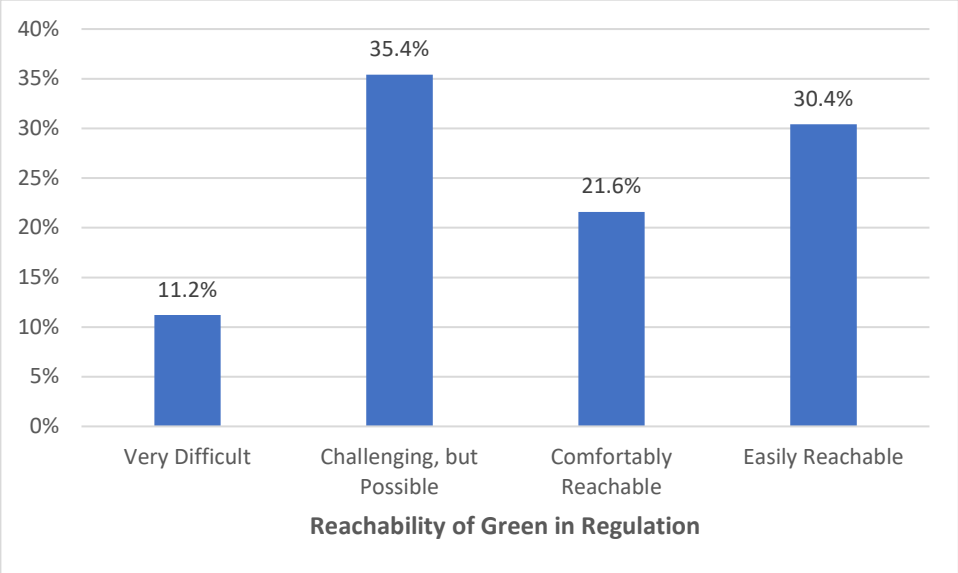
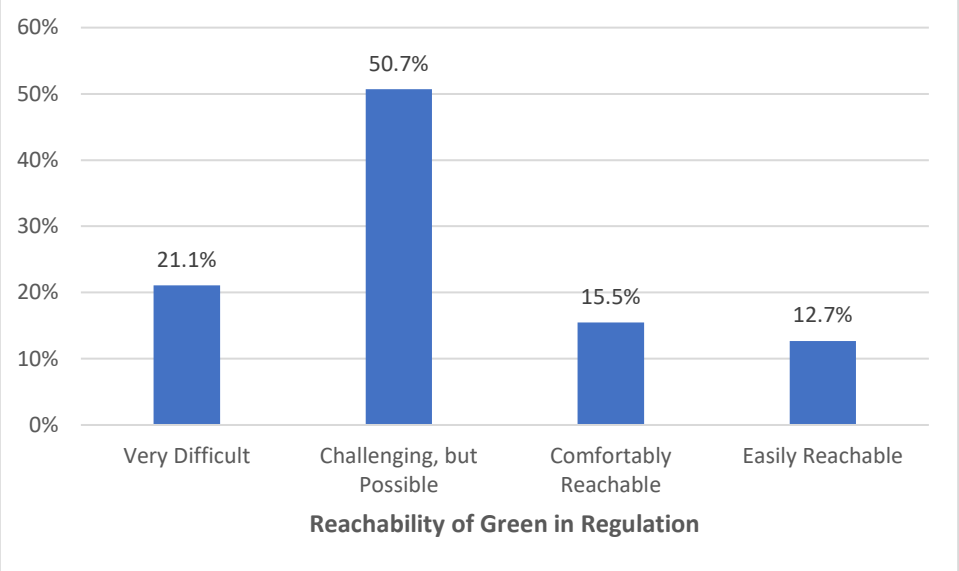


Figure 5: Reachability of Par 5s in Regulation (Female Golfers)



Discussion

In this sample of golfers, only 8% of males reported that par fours were very difficult to reach in regulation and 11% reported the same for par fives. This compares to 36% of females who find par fours very difficult to reach in regulation and 21% reported the same for par fives. On its face, this disparity suggests that male and female golfers have a different experience with decision

making that is based on hole reachability. Compounding this finding is the analysis that females who participated in the current study have lower handicaps (USGA, 2020) and drive the ball farther than typical female golfers (Arccos, 2020). As will be seen in following questions, the reachability of par fours and par fives for female golfers appears to influence their decision making and club selection from the tee.

Although the reachability findings of Research Question 1 are not the focus of the current study, the analysis may be useful for other projects within the USGA that consider golf course design and gender disparities in the golf experience.

Research Question 2: Did obstacles, penalty areas or forced carries influence golfers' club selection?

Golfers were asked if there were significant obstacles, penalty areas or forced carries that influenced their club selection on the hole they imagined when answering survey questions. The influence of obstacles, penalty areas or forced carries had a correlation significant main effect (r <0.10 is statistically significant) on whether golfers were playing par fours of par fives. On par fours and par fives respectively, 59% and 70% of golfers reported that an obstacle had influenced their choice of club.

When the data were split by gender, obstacles had more of an influence on male's club selection than female's club selection. On par fours, 60% of males and 48% of females indicated that penalty areas influenced their decision making. On par fives, 70% of males and 66% of females made decisions about club selection based on obstacles, penalty areas or forced carries. However, these differences were not statistically significant.

To understand other variables related to the influence of obstacles, penalty areas or forced carries on golfers' club selection, a correlation analysis was conducted. Significant relationships are noted below (r< 0.10).

- As golfers' average score increased, they were less likely to be influenced by obstacles, penalty areas or forced carries (r = .07).

- As golfers' reported increased driving distance, club selection was less likely to be influenced by obstacles, penalty areas or forced carries (r = .08).
- Controlling for golfers' average score, the relationship between reported driving distance and influence of obstacles on club selection remains significant (r = .05).
- As type of play became more competitive, golfers' decision making was more likely to be influenced by obstacles, penalty areas or forced carries (r = .05).

Discussion

For this sample of golfers, golf course design that incorporates strategically placed obstacles, penalty areas or forced carries can have an influence on golfers' club selection. This is consistent with findings of other researchers (McFall & Rotthoff, 2020; Nicholls & Polman, 2008; Pilgrim et al., 2016).

However, the influence of obstacles appears to be mitigated by golfers' driving distances. This remains the case even when controlling for golfers' ability, as measured by their average golf score. As golfers' driving distances increase over time, course design that may have influenced golfers' decision making in the past could become outdated.

Findings of Research Question 1 are consistent with reports and policy decisions from the R&A (2018): *Playing Lengths of Golf Courses Used for Amateur Golf Competitions in the United States. Distance Insights Resources* as well as from R&A (2019): *Lengths of Golf Courses on the Professional tours. Distance Insights Resources.* The studies reported that golf course length for championships has increased by an average of 10 yards per decade. To retain the relevancy of course design for increased driving distances, many courses have been lengthened.

Research Question 3: What club do golfers use from the tee?

In the study's sample, 1,184 golfers indicated that they were imagining a hole that was a par four, and 1,076 imagined playing a par five. Overall, golfers chose to use a driver on both par fours and par fives. Golfers hit a driver, regardless of their level of confidence, 84.12% of the time on par fours and 91.36% of the time on par fives (Figures 6 and 7). Almost 90% of participants indicated that their tee shot was good quality.

The data were split by the par of hole to investigate if the decision making of golfers' club selection varied significantly based on whether they were playing a par four or a par five. Golfers on a par five were significantly more likely to use a driver than golfers on a par four $t(2258) = 6.04$, $p < .01$.

Lastly, the data were split by gender, female reported that they were significantly more likely to use a driver from the tee on par fours than male, $t(973) = 1.99$, $p < .01$. The same trend was seen on par fives, but the difference did not reach significance.

Figure 6: Description of Golfers' Club Selection from the Tee (Par 4s)

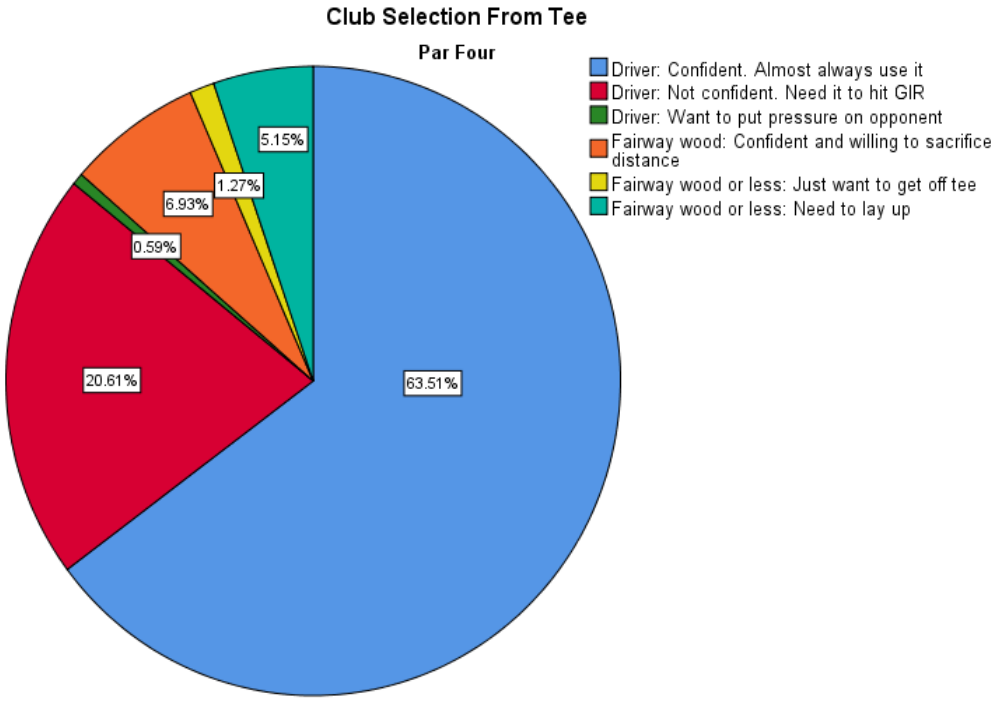
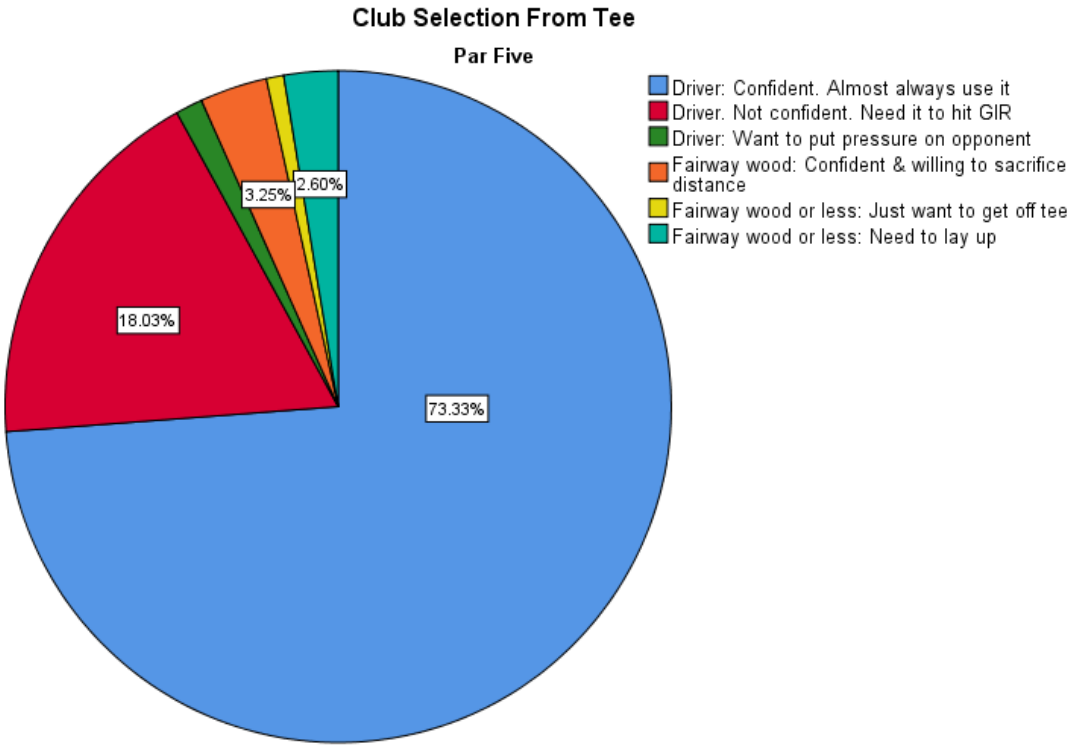


Figure 7: Description of Golfers' Club Selection from the Tee (Par 5s)



Discussion

The findings of Research Question 3 suggest that the driver is golfers' default club to hit from the tee on both par fours and par fives. This trend is consistent with findings by Barzeski & Wedzik (2014). The authors argue that driving distance is more important than short game proficiency if golfers wish to improve their score. This finding is also consistent with Broadie (2008) who argues that playing approach shots from the rough has less of a detrimental effect for amateur players than professional players. Therefore, amateur players should emphasize distance over accuracy when hitting driver.

Although the default club for golfers to hit from the tee is a driver, there was a significant difference between club selection based on the par of the hole. We can only hypothesize about the explanation for this – i.e., a longer hole

required more distance from the tee, or a bad tee shot can be recovered from on a par five – nonetheless, the findings are consistent with a study by Elmore and Urbaczewski (2020). They found that players scored lower when a hole was changed from a par five to a par four, even without fundamentally changing the physical distance or design of the hole. The authors controlled for other variables that could account for the difference in scores – e.g., weather, players' ranking, technology – and concluded that professional golfers are risk adverse and therefore take more care on a par four. This rationale could also explain the findings in the current study as to why golfers were more likely to hit a driver on a par five then a par four.

The propensity for female golfers to be more likely to hit a driver from the tee than male golfers is consistent with the finding in Research Question 1; that female golfers find par fours and fives less reachable than male golfers. It is a logical strategic decision for female golfers to maximize their tee shots with a driver if they want to increase their likelihood of reaching the green in regulation. More research is needed in this area to determine if female golfers use a driver from the tee as a strategic decision, or whether it is out of necessity due to the hole length and its perceived reachability. Current literature does not identify a gender difference in golfers' decision making, but it should also be noted that few studies included female golfers in the sample of participants.

Research Question 4: What variables predict golfers' choice of club from the tee?

To understand what factors may influence golfers' club selection for their tee shot, regression analyses were conducted. Analyses were conducted and reported independently for par fours and par fives. The F-statistic introduced below is a value you get when you run a regression analysis to find out if the means between two populations are significantly different. If the associated p-value is less than .05, then there is sufficient evidence to conclude that your regression model fits the data.

Par fours. When playing a par four, there were four variables that significantly predicted club selection from the tee. As players' reported driving distance increased, $F(8,875) = 2.16$, $p = .03$, and the hole was perceived as more reachable, $F(8,875) = 4.82$, $p < .01$, golfers were more likely to hit a fairway wood, hybrid, or long iron for strategy. Players were also more likely to hit shorter clubs from the tee if they were influenced by obstacles or penalty areas on the hole they were imagining, $F(8,875) = 4.02$, $p < .01$. The final significant factor was their perceived accuracy relative to their playing partners, $F(8,875) = 4.56$, $p < .01$. Golfers who considered themselves "*Much more accurate than most golfers I have played with*" were significantly more likely to use a driver from the tee than golfers who considered themselves "*Much less accurate than most golfers I have played with.*" It is noteworthy that average score, type of play or familiarity with a course did not predict club selection from the tee.

Par fives. Only three variables predicted golfers' club selection from the tee on par fives. Golfers were significantly more likely to hit a shorter club if they reportedly drove farther, $F(8,875) = 2.22$, $p = .03$, if they were navigating obstacles and penalty areas, $F(8,875) = 3.13$, $p = .02$, and if they perceived themselves as less accurate with the driver than other golfers, $F(8,875) = 4.30$, $p = .03$. As with par fours, players' average score, type of play or familiarity with a course did not predict club choice from the tee. However, unlike with par fours, reachability of the hole was not a significant predictor of club selection from the tee.

Discussion

Golfers in this study indicated that their choice of club from the tee was most influenced by their own driving distance, obstacles and penalty areas, and their own accuracy with the driver. These findings support existing research that also identifies the influence of penalty areas on club selection (McFall & Rotthoff, 2020; Nicholls & Polman, 2008; Pilgrim et al., 2016), accuracy (Broadie, 2008; R&A, 2017), and golfers' driving distance (R&A, 2017).

Other existing research around golfers' decision making has suggested that golfers' skill level either *should* affect their decision-making process (Johansson, 2015), or *does* affect their decision making (Whitehead et al., 2016a). In the current study, golfers' skill level was represented by their average score.

However, in this analysis skill was not a significant factor for predicting tee-shot club selection. The discrepancy between the findings may be explained by the different level of risk that high- and low-skilled golfers are willing to take. Ozbeklik and Kiholm-Smith (2017) reported that higher-ranked players in a tournament were more risk averse than lower-ranked players. Extrapolating that hypothesis to the current study, ability may not be predictive of club selection because higher-skilled golfers may decide to use a driver from the tee because they have assessed the risk and decided it is a good strategy. Lower-skilled golfers may make the same decision, but not because of the same risk assessment, rather they have a higher tolerance of risk despite their skill level.

Research Question 5: What variables predict golfers' choice of approach shot?

Participants were asked to rank considerations given to deciding what club to hit for their approach shot. The decision-making survey allowed for data analysis of different scenarios: the par of the hole, the club hit from the tee, and where the tee shot finished. For each variable that was ranked, a mean score was calculated to identify the most important factor considered for the approach shot. A low mean indicates that the variable is considered more important than a variable with a higher mean. Variables with the lowest mean in each category are presented in the table below and split for whether golfers perceived their tee shot as quality, or not. As only 11.3% of golfers reported that they did not hit a quality tee shot, the sample size for decision making in this category is small. Therefore, the findings for non-quality tee shots should not be generalized (Table 1).

Table 1: Top-Ranked Variables for Golfers' Club Choice on Approach Shots.

	Outcome of tee shot			
	Fairway	**Rough**	**Bunker**	**Penalty area**
Par 4: Quality shot	Distance (M = 2.04) n = 846	Distance (M = 2.05) n = 152	Lie (M = 2.30) n = 10	-
Par 4: Poor shot	Distance (M = 1.91) n = 23	Lie (M = 2.83) n = 102	Lie/Distance (M = 2.71) n = 7	Distance (M = 2.04) n= 12
Par 5: Quality shot	Distance (M = 2.21) n = 820	Distance (M = 2.17) n = 121	Lie (M = 1.25) n= 4	-
Par 5: Poor shot	Make par (M = 2.32) n = 19	Lie (M = 2.82) n = 69	Lie (M = 2.43) n = 7	Distance (M = 2.83) n = 6

Discussion

The results of Research Question 5 suggest that after a quality drive on a par four and par five, distance to the green is the most important factor regardless of whether the tee shot stays on the fairway or lands in the rough. This is consistent with recommendations in "Every Shot Counts" (Brodie, 2008). Brodie argues that amateur players' performance remains stable with their approach shots – regardless of whether they are hitting from the fairway or rough.

Distance remains the most important factor after a non-quality drive on a par four if it stays in the fairway. But on a par five, the most important consideration after a non-quality (short) drive that stays on the fairway is making par – this could be because optimal distance from the tee has been compromised. Otherwise, the lie from the rough or a bunker appear to be the most important considerations for deciding what club to hit for the approach shot.

These findings reflect those of McFall and Rotthoff (2020) who reported that for approach shots, distance to the hole and lie have significant influence on golfers' decision making. For professional golfers, a shot with a distance between 200- and 225-yards reduces their risk-taking by 7%. More-challenging lies like playing from rough instead of fairway, significantly reduces risk taking. And

according to Strunk et al. (2015) it should. In their study with 7-irons, backspin, "smash factor" (ratio of ball speed to club head speed), ball speed and distance increased with a better lie. Water and other penalty areas also significantly decreased golfers' risk taking.

It should be noted that Whitehead et al., (2016b) compared "think-aloud" data – information spoken out loud and collected during golfers' decision making (refer to paper for a thorough explanation of this method)– to data collected from retrospective interviews about golfers' decision making. Interviews conducted 10 minutes, 24 hours and 48 hours after play varied from what golfers reported earlier during in-the-moment, think aloud protocols. This suggests there can be some reliability issues with retrospective data collection. An example of this is that nearly 90% of the current study participants reported their shot from the tee as a quality shot. However, another explanation could be that golfers simply chose to recall a golf hole that they played well for the purpose of the study.

SECTION 2: GOLFERS' GENERAL ON-COURSE DECISION MAKING

In section two of the study, participants were asked to think about their general on-course decision-making strategies.

Research Question 6: In general, what factors are most influential in golfers' oncourse decision making?

Given a list of factors that may influence on-course decision making, golfers were asked to rank them in order of importance (1 = most effect on decision making, 6 = least effect on decision making). The data were organized in two ways. First, a mean score for each item was calculated to determine its perceived overall effect on decision making. A low mean score indicates that the factor has a large effect on decision making and a higher mean score indicates that a factor has less effect. This analysis accounts for golfers' aggregated perception of importance for each factor – considering its position when not ranked as most important. Second, a frequency analysis was conducted to identify which factors were most often ranked as the most important to golfers' decision making (Table 2).

Table 2: Top-Ranked Variables for Golfers' Decision Making.

Rank	Factor	Mean (SD) *n* = 2060	# Times Listed First
#1	Confidence	2.26 (1.22)	34.7%
#2	Shot difficulty	2.28 (1.26)	34.6%
#3	Shot importance	3.31 (1.39)	11.6%
#4	Round importance	3.61 (1.43)	10.5%
#5	Gut instinct	4.40 (1.50)	6.2%
#6	Warm-up	5.13 (1.27)	2.6%

In this sample of golfers, confidence, i.e., *"how well I am playing or struggling with my game,"* and difficulty of a particular shot ranked as the two most influential factors on both types of analysis. As in Research Questions 3 and 4, shot importance and type of round factored substantially lower in terms of importance for decision making.

Discussion

The findings in Research Question 6 both supported and diverged from existing literature around golfers' decision making. Consistencies were found in two factors that ranked highly in decision making – shot difficulty (Cotterill et al., 2010; Nicholls & Polman, 2008; Pilgrim et al., 2016) and confidence (Hellström, 2009; Oliver et al., 2020). A shot was deemed "difficult" based on its distance (McFall & Rotthoff, 2020), lie of the ball (Strunk et al., 2015) and weather conditions (R&A, 2018a). However, as Hellström suggested, good decision making and strategy requires an assessment of the past and planning for the future. That is, confidence. Players must consider "the whole chain of events" that pivot around a decision. When done so, this will affect confidence for the shot being played.

The finding diverged from research concluding that for male golfers, logical decision making is frequently outrun by situational gut feelings, or a sense of "manning up" (Gnagy et al., 2015). In the current study, only 6.2% of golfers reported a "gut feeling" as the most important factor for on-course decision making. This discrepancy can be explained in part by sample size and potential age of participants. Gnagy et al. (2008) interviewed three golfers described as "developing professional players" in their qualitative study. By comparison, the current study collated the responses of 2,060 golfers of unknown age.

Research Question 7: In general, what factors are most influential in golfers' putting decision making?

Given a list of factors, golfers were asked to identify only the *first* consideration or the most *important* decision when putting. The options were not ranked as in Research Question 6 (Table 3). The speed of the putt accounted for over 35% of golfers' first putting consideration. This was followed by "My line" and "Break of the putt" or "Depends on length and situation".

Table 3: Variables Identified by Golfers as Most Important for Putting

Rank	Factor	# Times Listed First *n* = 2060
#1	Speed of the putt	35.3%
#2	My line	32.1%
#3	Break of the putt	21.8%
#4	Depends on length and situation	7.6%
#5	My technique	3.1%

Discussion

Studies based around putting are plentiful in academia due to the convenience of study design. It is interesting, therefore, to compare findings from laboratory-based research studies to the current field data.

As reported by Tenenbaum and Calmerio (2011), golfers appear to gather information to inform their strategy. The speed, the line and the break of putt would fall into this category. The authors also suggested that novice golfers are less likely to focus on these factors and instead focus on their technique. In the current study, only 3.1% of golfers identified technique as their most important consideration when putting. This is despite a range of scores between 70 and 126 (*ML* = 86.48, *SD* = 7.47). However, the current study design did not allow for the relationship between golfers' ability and technical focus to be explored further.

Economic researchers Pope and Schweitzer (2011) used professional golf to test assumptions and behavior bias in decision making. The researchers analyzed players' success rate based on whether the putt was for par or a different score. They concluded that golfers were less likely to make putts if they were for a birdie or eagle compared to a par or bogey. Despite only 7.6% of golfers in the current study indicating that the situation of the putt affects their decision, it may have a disproportionate effect on the outcome of the putt. It was not possible to test this hypothesis with the available data in the current study.

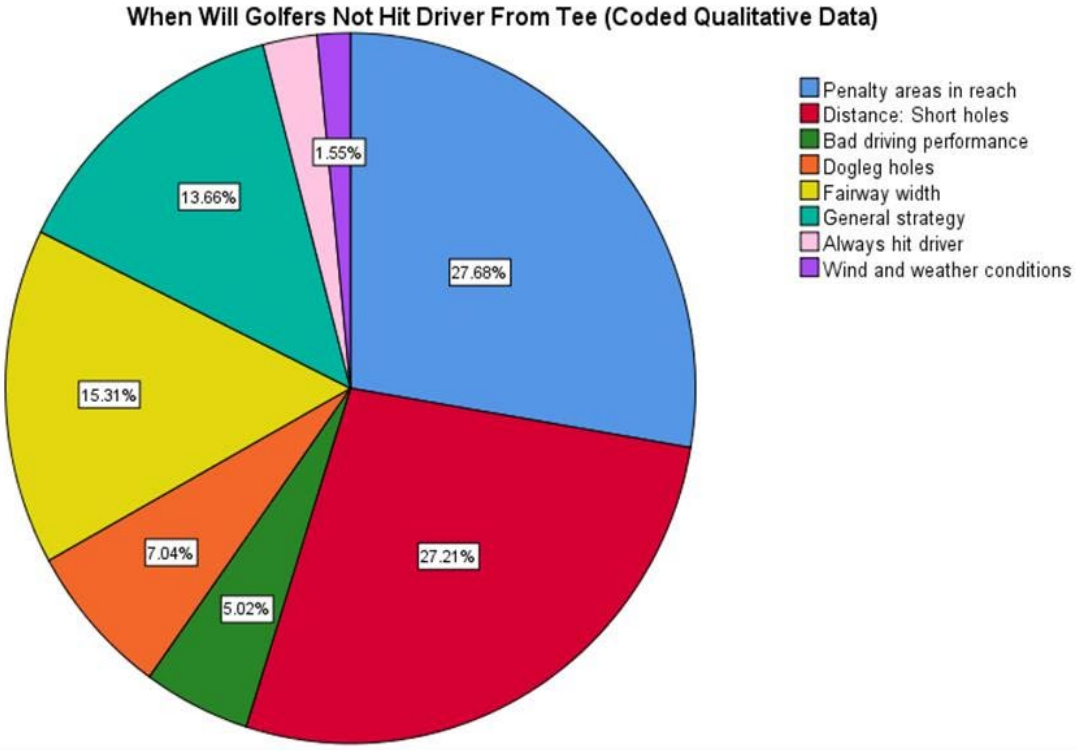
Research Question 8: In what situations will golfers choose to hit something other than a driver from the tee?

Study participants were asked to describe a situation in which, *"You would choose to use a fairway wood, hybrid or iron off the tee instead of driver. Please include any factors that you think are relevant to that decision (penalty areas, fairway width, poor driving performance, etc.)"*

Golfers could write their own response to this question. The qualitative data were sorted in two ways. First, the data were sorted using themes extracted from the responses. Many participants provided several situations that may affect their decision not to use a driver from the tee. In this instance, the response was read in full and the data were coded based on what was concluded as the underlying reason for the decision. The data fell into eight different themed

categories. Second, these categories were then analyzed for frequency which provided an overview of factors golfers considered most often when deciding to use a club other than the driver from the tee. Two factors accounted for over 50% of the decisions not to hit a driver: when a penalty area was in reach, and on shorter holes where a driver from the tee would either go too far or was unnecessary (Graph 8).

Graph 8: When Do Golfers not Hit Driver From the Tee



Themed categories and examples of data within each category are provided below. The qualitative data provided examples of the complex decision-making process golfers engage in on the golf course. They appear to constantly weigh the past and future, the pros and cons of choosing one club over another and assess how external factors will affect the shot outcome, e.g., lie of the ball or weather.

The examples of responses in the following categories reflect themes that appeared to underpin golfers' decisions when choosing not to hit a driver from the tee.

Penalty areas in reach

"Water. That's about it. If water sits in my landing zone, I'll lay up. Generally though, I'm gonna let the big dog eat. I wanna hit that thing 16 times per round."

"Bunker or penalty area that could come into play with a driver; how far out I want to be for my next shot; how tight the landing zone is; how firm the fairways are."

"Penalty area, bunker or significant narrowing of fairway in landing area of driver. Basically to avoid trouble due to length of shot. Also, where using less club gives me a full shot into a green."

Distance: Short holes

"Shorter hole and most of the time simply depends on the distance I want to leave myself to the hole – the club I want to hit into the green."

"Par 3 yardage and wind."

"200 yard par three. Driver too long."

Bad driving performance

"How well I'm hitting my driver, especially if the fairway is narrow or there are significant penalty areas."

"If I'm struggling with my driver, I may play conservative and use one of my hybrids instead."

"If having a bad day with the driver, I might use a fairway wood or long iron off the tee until I felt I could go back to the driver. Would use an iron on a short par three."

Dogleg holes

"Dogleg, where driver would send it out of bounds."

"Shape of the hole. Tighter left to right fairway. Confident with 3 wood going left to right, with just a little longer second shot and sometimes the 3 wood is as long as my driver."

"Dogleg right, which I control the fade well."

Fairway width

"Very tight fairway or water hazard that might come into play from hitting driver."

"Narrow fairway. Hole still reachable in regulation."

"Fairway is too narrow at driver distance and green can be easily reached with a short iron after less than driver off the tee. Also, more comfortable shaping a draw with less than driver."

General strategy

"I pick a target, and choose a club to hit that target, considering environmental conditions and how I am playing. Choosing the target involves evaluating penalty areas, fairway width, as well as desired position for next shot."

"When less than driver will better set up approach – factors: fairway slope and width, flat or sloped lie in fairway for second shot, wind, uphill/downhill. Layup short of penalty area if it's there."

"Generally, I think about what shot I want for my second shot. As an example, hitting slightly shorter to have a flat rather than downhill lie. Fairway width may be a factor although I am generally thinking only about what Is required for the hole in question."

Always hit driver

"I'm more confident with my driver than my 3 wood off the tee. So for a par 4 or 5 I almost always use the driver (98%), as I'm not a long hitter, about 210-220 typically, and don't often outhit a fairway from the tee."

"I rarely use a club other than a driver off a tee, except par3's. The only exception is if I think my drive will get into trouble by hitting too long. I can be fairly accurate with a driver."

"Never."

Wind and weather conditions

"In a facing wind, when it is important to land in the fairway, particularly if the driver is not performing well that particular day."

"Wind blowing hard towards me. I always slice if I use my driver against the wind where, although I lose yardage off the tee, it is straighter."

"High winds, dry conditions favoring run out, fairway width, need for distance."

Discussion

The qualitative data used to answer Research Question 8 confirms that golfers consider various factors simultaneously when deciding whether or not to hit a driver from the tee. The answers generated in this section of the study suggest that golfers are continuously weighing different aspects of the hole that are of concern or interest to them. For example, the same player may make a different decision about hazards on the hole and their typical driving distance based on their performance that round or the weather conditions. Similar findings were reported by Nicholls and Polman (2008), Cotterill et al. (2010), Giacobbi et al. (2004), Lavallee et al. (2003) and Pilgrim et al. (2016).

However, when the data were analyzed, penalty areas and length of the hole were the biggest influence on golfers' decision making from the tee. This

result is consistent with the findings of a regression analysis in Research Question 4.

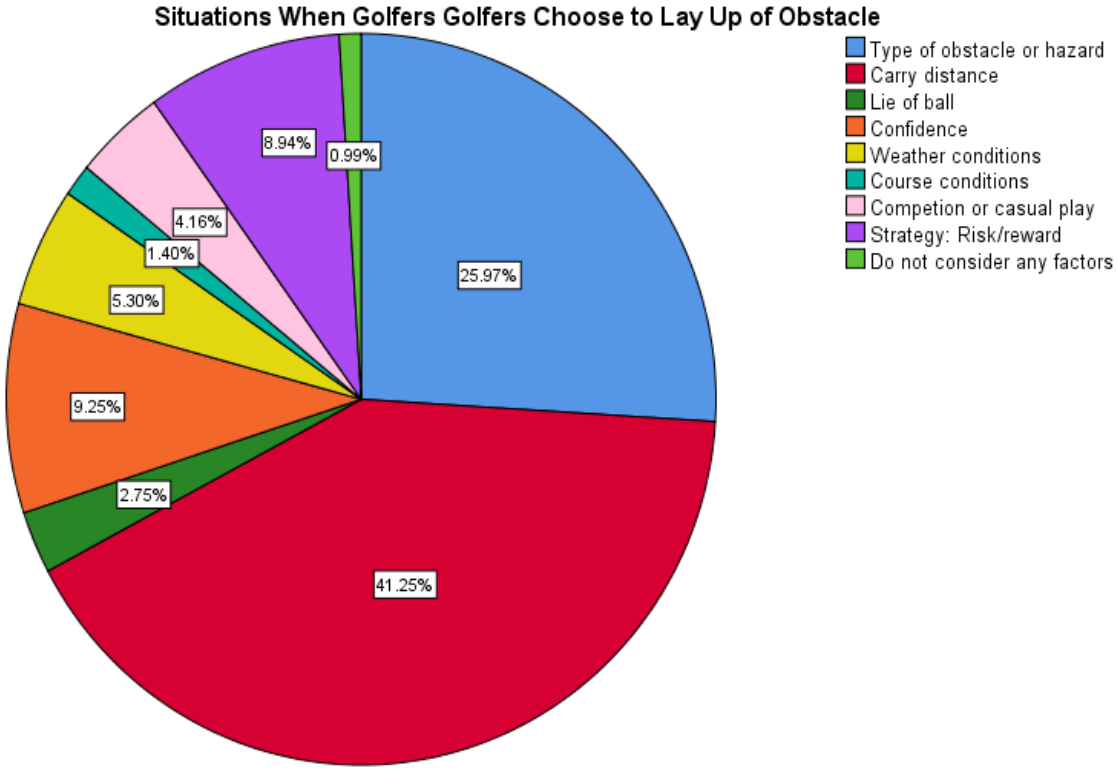
Research Question 9: In what situations will golfers choose to lay up instead of trying to carry an obstacle?

Study participants were asked to describe a situation in which, *"You would choose to lay up in front of an obstacle or forced carry versus trying to clear it. Please include any factors you think are relevant to that decision. Factors included: type of penalty area, carry distance/club needed, how well you are playing, competitive situation, and others"*

Data were analyzed in the same way as in Research Question 8 to extract common themes to provide an overview of the findings (Graph 9). The response was read in full, and the data were sorted based on what seemed to be the underlying reason for the golfer's decision making. Nine themes emerged from the data.

After the data were sorted, a frequency analysis was conducted. Forty-one percent of respondents indicated that carry distance was the first consideration when deciding whether to lay up or attempt to carry an obstacle. The type of obstacle being considered underpinned the next most frequent consideration (26%).

Graph 9: Situations When Golfers Lay Up Short of Obstacles



Examples of data in each category are provided below:

Type of obstacle or hazard

> *"Almost always if it is water or an area that is not playable and requires more than a 4 or 5 hybrid."*
>
> *"A water hazard crossing the fairway or in front of the green."*
>
> *"Any type of obstacle in front of the green (water hazard, bunker, etc.). An extremely downhill or uphill lie would also affect my decision."*

Carry distance

> *"If I know I cannot carry an obstacle I will lay up every time."*
>
> *"If I have a reasonable chance of clearing an obstacle, I normally will try to clear it. In a competitive round I'll be more conservative – maybe 80-90%*

confidence vs. 50-60% in a normal, fun round – but my instinct is always to try for the hero shot and I have to fight against that in my decision making."

"I would choose to lay up if the carry was too long for a club I have a lot of confidence in, especially if the obstacle is one that will cause a lost ball."

Confidence

"How well I am hitting the ball on a given day."

"How I am playing weighs heaviest. Next would be competitive situation. All other instances [I] will generally lay up."

"Confidence level. If it's a match play situation and my opponent is in good position. If it's a penalty area or has thick grass or brush."

Strategy: Risk/reward

"It's a risk reward thing. I'll weigh the odds. Am I willing to take the chance or play safe and trust my short game."

"I'm a short hitter and I HATE to take a penalty stroke. I avoid penalty strokes in almost every situation."

"If it's a par 5, then I would definitely lay up. If it's a par 4, then I would believe that I would think I could clear it even in competition. I'm braver going over bunkers than over water though. Water probably means I would lay up."

Weather conditions

"Strong head winds or cross winds"

"Hot or cold day. is the wind in my face or helping me. If have to clear sand, don't worry much. if it is water or garbage, I have to carry it."

"1) Elements/weather considerations. 2) Wind with or against me. 3) How I am hitting the ball that day. 4) If playing a match to be safe."

Competition or casual play

"Strokeplay - determined by my ability to carry the obstacle. Matchplay - state of play on the hole in question."

"In a non-competitive situation, I'll hit a layup to work on my short game. Not having enough club length."

"In competition is [a] safe shot the right play? In [a] fun round is losing a $4 golf ball in the lake worth trying for the shot?"

Lie of the ball

"If I was in deep rough."

"First would be the lie of the ball, next the club required and/or difficulty of the shot required to cover the yardage needed. In a competition, I would probably err on the side of caution."

"It would likely be a downhill lie to an elevated green with a hazard between. I'd try to lay up as close to the hazard as possible."

Course conditions

"Pin location and bunker between me and hole."

"1) Greens condition: soft or hard. If hard, I will play a shot in front and with the Gods of golf with me it may roll unto [the] green. If soft and even with [an] undulating green, I will go for it. 2) Wind conditions will be a factor if [it's a] forced carry over water, and [the] lie of ball on fairway if I am hitting against the grain or with the grain."

"Fairway conditions for the next shot, the club needed to carry the next shot. Making the right decision based on my ability."

Do not consider any factors

"I am not a good enough golfer to even consider this."

"I rarely lay up for safety. Maybe only when I hit a poor drive and very short distance and there is trouble or a hazard. In competition, such as match play, I may lay up if I'm ahead and in position to close out my opponent."

"Don't really play shots to lay up."

Discussion

The qualitative data generated in Research Question 9 suggests that multiple factors are considered when deciding whether to lay up in front of an obstacle. Based on how the question was written, it was not clear if this question was referring to the decision that golfers make from the tee, or with subsequent shots. Or both. Consequently, some participants seemed to answer the question as if they were contemplating a tee shot and others a subsequent shot, i.e., they considered the lie, which of course, would not be relevant from the tee.

When analyzed, the qualitative data told a convincing story. As found in Research Question 4 and 8, carry distance over an obstacle or penalty area and the type of obstacle or penalty area were fundamental drivers of golfers' decision-making process (McFall & Rotthoff, 2020; Nicholls & Polman, 2008; Pilgrim et al., 2016; R&A, 2017).

STUDY LIMITATIONS

The USGA On-Course Strategy and Decision-Making Study adds to the knowledge base about golfers' decision-making processes. It also provides data that supports general trends in extant research. However, there are notable limitations to the analyses conducted and conclusions drawn from them.

Demographic information

Demographic information collected from participants was limited. For example, golfers' age, education level, number of years playing, and frequency of play would have enhanced the findings.

Study sample

Finding representative samples of the golf population is difficult. However, it is noteworthy that from the demographic information that was collected, female golfers in the current study were underrepresented. As we do not know other demographic information about study participants, it is difficult to determine if the sample was representative of the overall U.S. golf population.

Study design

The study design put some limitations on analyses that could have been extracted from the data. For example, items "ID: 59" and "ID: 26" could have been written with psychometric rating methodology such as the Likert-type scale response. With nuanced data sitting on a continuum, it would have been possible to build more-informative predictive models about decision making from the available items and data.

Examples

> **ID: 59 suggestion**. On a scale of 1-10, how much influence did obstacles, penalty areas or forced carries have on your club selection? (1 = little to no influence, 10 = most influence.)
>
> **ID: 26 suggestion**. Tee shot – what type of club did you decide to hit off the tee and why? Each option could have been written in the following way:

Additionally, it is recommended that items contain just one construct instead of multiple constructs. For example, item "ID: 32" asks golfers to identify the *"…first consideration or the most important decision you make when putting?"* From the data, it is not possible to discern whether golfers are responding to the first or the most important factor when making decisions about putting. In addition, the option, *"Depends on the length and if the putt is for birdie, par or*

worse" conflates two potentially independent factors about decision making – the length of the putt and what score it is for. Therefore, it is not possible to know which factor respondents are referring to. Consequently, this reduces the validity of the findings.

Lastly, the qualitative data found in items "ID: 34" and "ID: 35" provided a richer understanding of variables golfers consider when teeing off and hitting approach shots. However, the items themselves primed participants with responses. Therefore, the data garnered from these items matched the suggested reasons given in the item description. It is recommended that open-ended questions do not influence or suggest ways that participants should respond.

REFERENCES

Arccos (2020). Arccos driving distance study. Retrieved from: https://mygolfspy.com/arccos-driving-distance-study/

Barzeski, E., & Wedzik, D. (2014). *Lowest Score Wins. Techniques, Stats and Strategies to Shoot Lower Scores on the Golf Course NOW. Analyzr Golf L.L.C*

Broadie, M. (2008). Assessing golfer performance using golfmetrics. Science and Golf V: Proceedings of the World Scientific Congress of Golf, (34), 253–262.

Brodie, M. (2014). *Every shot counts.* Gotham Books, New York, NY.

Cotterill, S. T., Sanders, R. & Collins, D. (2010). Developing effective preperformance routines in Golf: Why don't we ask the golfer? *Journal of Applied Sport Psychology*, 22(1), 51-64.

Elmore, R. & Urbaczewski, A. (2020). Loss aversion in professional golf. *Journal of Sports Economics.*

Giacobbi, P., Foore, B. & Weinberg, S. (2004). Broken clubs and expletives: The sources of stress and coping responses of skilled and moderately skilled golfers. *Journal of Applied Sport Psychology,* 16(2), *166-182.*

Gnagy, E., Dixon, M., Clingerman, E. & Bartholomew, J. (2015). An exploration of strategic decision making in golf: Take a chance, it's worth the risk. *International Journal of Golf Sciences*, 4, 89 -109.

Hellström, J. (2009). Psychological hallmarks of skilled golfers. *Sports Medicine*, 39(10), 845-855.

Johansson, U., König, R., Brattberg, P., Dahlbom, A., & Riveiro, M. (2015). Mining trackman golf data. International Conference on Computational Science and Computational Intelligence, 381–386.

Lavallee, D., Bruce, D., & Gorely, T. (2003). The golfer-caddie partnership: An exploratory investigation into the role of the caddie. *Science and Golf IV*, 284-297.

McFall, T. & Rotthoff, K. W. (2020). Risk-taking dynamics in tournaments: Evidence from professional golf. *Journal of Economic Behavior and Organization,* 178, 378-394.

National Golf Foundation (2020). Golf industry facts. Retrieved from: https://www.ngf.org/golf-industry-research/

Nicholls, A. R. & Polman, R. C. J. (2008). Think aloud: Acute stress and coping strategies during golf performances. *Anxiety, Stress, & Coping*, 21(3), 283294.

Oliver, A., McCarthy, P. J., & Burns, L. (2020). Using a "Think Aloud" protocol to understand meta-attention in club-level golfers. International Journal of Sport and Exercise Psychology, 1 – 14.

Ozbeklik, S. & Kiholm Smith, J. (2017). Risk taking in competition: Evidence from match play golf tournaments. *Journal of Corporate Finance,* 44, 506-523.

Pilgrim J., Robertson S. & Kremer P. (2016). A qualitative investigation into the role of the caddie in elite-level golf. *International Journal of Sports Science & Coaching*, 11(4),599-609.

Pope, D. G. & Schweitzer, M. E. (2011). Is Tiger Woods loss averse? Persistent bias in the face of experience, competition, and high stakes. *American Economic Review*, 101(1), 129-57.

R&A. (2017). *Club Decision Making Model*. Distance Insights Resources.

R&A. (2018). *Playing Lengths of Golf Courses Used for Amateur Golf Competitions in the United*. Distance Insights Resources.

R&A. (2018a). European Tour Weather Conditions and Relationship with Driving Distances. Distance Insights Resources.

R&A. (2019). *Lengths of golf courses on the professional tours*. Distance Insights Resources.

Strunk, W. D., Karcher, D. E., Young, J. R., Patton, A. J. & Richardson, M. D. (2015). Golf shot performance characteristics influenced by ball lie. Crop, Forage & Turfgrass Management.

Tenenbaum, G. & Calmeiro, L. (2011). Concurrent verbal protocol analysis in sport: Illustration of thought processes during a golf-putting task. *Journal of Clinical Sport Psychology*, 5, 223-236.

USGA (2020). Handicap Index Statistics. Retrieved from: https://www.usga.org/content/usga/homepage/handicapping/handicapping-stats.html

Whitehead, A., Taylor, J. A. & Polman, R. C. J. (2016a). Evidence for skill level differences in the thought processes of golfers during high- and low-pressure situations. *Frontiers in Psychology*, 6, 1974.

Whitehead, A., Taylor, J. A. & Polman, R. C. J. (2016b). Examination of the suitability of collecting in event cognitive processes using Think Aloud protocol in golf. *Frontiers in Psychology*, 6, 1083.