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Does the Combination of Experience and Strong Incentives Eliminate Loss Aversion? -- Evidence from the 2019 and 2020 U.S. Open and Masters Golf Tournaments Indicates It Does Not

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Abstract

Perhaps the biggest caveats with respect to the perceived robustness of loss aversion in real-world decision making are findings that with repeated decisions and high stakes loss aversion goes away as decision makers learn from experience. The study reported herein shows that this is not necessarily the case.

This within-subjects study tracked individual player-performance, longitudinally, over their competitive rounds at the 2019 and 2020 U.S. Open and Masters golf tournaments. These were the world's most elite players competing for the highest stakes in golf, highly incentivized to perform familiar activities that they have honed through a lifetime of practice and competition. Yet loss aversion was induced by the negative-framing that occurred naturally following scores of bogey-or-worse during their competitive rounds.

With a change in reference point after making bogeys, players made a significantly higher rate of birdies on the ensuing hole. In golf folklore this loss-aversion phenomenon is known as the bounce-back effect. And the results here are clear: neither experience nor high stakes eliminate loss aversion.

JEL Codes: C93, D01, D81, D91
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1. Introduction

Loss aversion – the notion that losses carry a greater perceived weight than equivalent gains – affects a full range of important decisions, from individual choices to the design of public policy. However, two criticisms of loss aversion have been prominent, and seen by some as compelling: a) that with repetition, decision makers will learn to avoid it; and, b) that evidence in support of loss aversion is based mostly on trivial sums (e.g., a mug, a pen, or small sum of money), not involving real exchanges (e.g., using hypothetical surveys instead) and that if sufficient incentives were present, people would not be loss averse.

List (2003) provided what is largely regarded as a persuasive example of this in field experiments involving the trading of sports memorabilia, e.g., sports cards and medallions, where more experienced traders exhibited significantly less loss aversion than more casual sports-memorabilia traders, who traded far less often. But perhaps it was not so much that the greater frequency of trades of the professional sports-memorabilia traders that enabled them to overcome their reference dependence, but rather that the reference states of professional traders are different from more casual sports-card traders.

Professional card-traders trade to make a living. Like shopkeepers who sell their wares without regrets, they view the trade of a piece of sports memorabilia as a necessary activity that they do to support themselves; whereas for casual traders – those traders who are not in the business – giving up a card or a medallion may be felt more as a real loss, not just giving up an item from inventory.

A more exacting test of loss aversion's relevance to experienced actors making truly consequential decisions can be found in the realm of professional golf tournaments. In a setting that is stacked against the showing of loss aversion, the present study tracks elite professional golfers – players who have honed their skills through a lifetime of practice and experience – competing for life-altering stakes in the world's two most prestigious tournaments: The U.S. Open and Masters championships.

Two previous studies have found evidence of loss aversion in professional golf; but both have important limitations, as discussed in greater detail below (Pope & Schweitzer, 2011; Elmore and Urbaczewski, 2020). One critical caveat though is that both studies use data from what is now, a bygone era in golf: the former from 2004 to 2009; the latter from 1992 to 2007. But a significant advantage of older studies is that they can serve as backdrops to test whether widespread knowledge of loss aversion in professional golf has eliminated it, a central element of the notion that experience and enhanced knowledge serve to eliminate loss aversion in real world situations.

Results from this study show that significant loss aversion was clearly evident amongst elite golfers in spite of: significant monetary and reputational incentives; vastly improved fitness amongst players coupled with a widespread adoption of more aggressive playing strategies; improved golf club technologies that enable a near perfect fit of clubs to players; Doppler radar training technologies that give players and their coaches fine-grained details about their skill levels, relative to others and themselves over time; and the ever-present advice to stay in the moment, playing each shot to the best of one's ability, without letting outcomes on previous holes, or previous shots, interfere with real-time performance.

This study adds weight to the view that it is primarily the nature or change in reference state that offers a more likely explanation for what is observed, rather than being due to inexperienced decision makers facing artificial, or trivial circumstances.

Why Professional Golf Tournaments? *Because in golf, you have to play your mistakes.*[1]

Poor shots lead to bogeys (+1 to par), double bogeys (+2), or worse (+n), while good shots rarely lead to anything better than a birdie (-1 to par). *This asymmetric reward-structure induces cautious play*; one bad hole in a stroke-play tournament can ruin a player's overall score for the full tournament. By comparison, in tennis, a bad shot can be immediately offset by a winning shot. Because it is easier to overcome errors in tennis, and most other sports, competitors play more aggressively. [2]

Players routinely guard against errors by playing away from water, trees, sand traps and out-of-bounds; avoiding downhill putts; playing to the center of greens rather than at holes located on the edges; and by lagging putts so that the next putt is from a makeable location.

But if decisions are reference-dependent, players would likely weigh the feeling of loss from a bogey more on the previous hole, encouraging an adjustment of their risk/benefit weighting towards riskier play on the ensuing hole in an attempt to eliminate the feeling of loss with a counterbalancing birdie.[3]

Evidence of this would be compelling support for the pervasiveness of Prospect Theory described behaviours (Kahneman & Tversky 1979; Knetsch 1989; Kahneman, Knetsch & Thaler 1990). It is a strong example of existential instantiation: evidence supporting a theory where you least expect it, enabling more confident inferences of its validity in more benign environments.

2. Previous Studies of Loss Aversion in Professional Golf

Two papers have investigated loss-aversion in professional golf: both were between-subject studies that made important, but necessarily more limited findings.

Elmore and Urbaczewski, (2020) found that professional golfers scored better on holes at U.S. Open championships when they were played as Par 4s than when played as Par 5s. The authors suggest that golfers anchored on par as a reference point and thus considered a bogey to be a loss from that reference point. Hence, they played more aggressively to avoid the loss.

The two holes chosen for comparison were the 2nd hole at Pebble Beach, California, played as a Par 5 in the 1992 U.S. Open, and as a Par 4 in the 2000 U.S. Open; and the 9th hole at Oakmont, Pennsylvania, played as a Par 5 in the 1994 U.S. Open, and as a Par 4 in the 2007 U.S. Open. Note that these comparisons are separated in time by 8 and 13 years respectively, and that the most recent data is 14 years old.

These time lapses confound the study's results in at least two significant ways: players may have scored better on these relatively short par 5s regardless of the designated par due to improvements in golf club and golf ball technology, and their own better physical training that occurred during the time between these events. And the sets of player-subjects competing in these championships were almost completely different due to the extended time between tournaments. In total, fewer than 20% of the participants in the earlier tournaments played in the latter tournaments, and they played the holes nominally worse as Par 4s than as Par 5s.

Pope and Schweitzer's (2011) investigation of loss-aversion showed that professional golfers on the PGA Tour were more aggressive, and successful, with putts for par (to avoid a loss), than similar putts for birdie (a potential gain). If golfers had not been loss averse, they would have hit birdie and bogey putts exactly the same.

[1] In stroke-play tournaments, the goal is to take the fewest total strokes for the 72 holes played (four rounds of 18 holes on consecutive days.)

[2] In contrast to stroke-play, match-play competitions in golf are between two individuals, with the winner determined by the number of holes won rather than the total number of strokes taken. A score of 7 versus a score of 3 counts as only one hole lost, rather than a four-stroke disadvantage. This reduces the stress from hitting errant shots and induces situational risk-taking to win or avoid losing a hole. Much like tennis, in match play you can make up for a lost hole by simply winning a hole.The PGA has 49 stroke-play tournaments per season, but only one match play event. However, most competitions between friends on weekend rounds of golf are played using match-play rules.

[3] As Kahneman and Tversky (1984) observed: "The assumption of risk aversion has played a central role in economic theory. However, just as the concavity of the value of gains entails risk aversion, the convexity of the value of losses entails risk seeking" (p. 342). Accordingly, people will weigh the reduction of a loss greater than a commensurate gain.

The authors calculate that player's scores would have improved by nearly one stroke over each 72-hole tournament if they had been as aggressive with birdie putts as they were with putts for par. Over a full season, this could have produced a significant increase in both earnings and win-probabilities for the top players. [4]

With 2½ million data points, Pope and Schweitzer present a strong case, and they are able to dissect their data to fend off many of the obvious caveats. But evidence from their study is not based on within-subject comparisons of actions made by the same players; *nor could it have been* since it is not possible for a player to attempt the same putt for both birdie and par. It was instead inferred from data aggregated across 421 professional golfers, comparing similar putts hit by *any* of these golfers, regardless of ranking, in 239 PGA tournaments – ranging in importance from major to minor – played over 6 years from 2004 thru 2009.

This design imposes significant limitations on the explanations of observed behaviour and includes confounding factors that weaken their conclusions.

2.1. The Physics of Putting:

The notion that putting more aggressively will lead to improved scores is too … linear.

Most PGA tournaments are played on greens that are relatively benign; aggressive putting works well on such greens. While other tournaments are played on greens so firm, fast and contoured, that player-aggressiveness must be more measured. Even the most casual observers of the U.S. Open and Masters golf championships for example, recognize that aggressive putting on the greens at these tournaments must be restricted to uphill putts – or players invite an early exit from the tournaments.

But when you bundle hundreds of players of different abilities playing in tournaments that range from major events played on very difficult golf courses with more numerous, minor events on easier courses, important subtleties, like the physics of putting, get overwhelmed. *(See the Appendix for a more complete articulation of the Physics of Putting.)*

The authors support their bundling choice by showing that their loss-aversion results are homogenous across the sample population, and not related to skill differences between PGA players. But they support this conclusion with an unfortunately crude calculation.

In a regression, they use the world rankings from 2007, while comparing putting data for every PGA event from 2004 through 2009. But player rankings change from week-to-week and can change dramatically from year to year, which creates an enormous amount of noise in this simple measurement, seriously weakening the chance of finding a relationship between skill-levels and putting performance.[5]

Breaking the clusters into more homogenous sub-groups would have enhanced the contextual validity of the study. For example, if they had taken the top players in the world, playing in only the most significant tournaments, they would have compared apples-to-apples. That would have reduced, but not eliminated, the black-box effect from clustering putts from the top-ranked players in the world with players ranked in the 200^{th} – 600^{th} range, for example, then drawing conclusions about the world's top players playing in the most significant events.

2.2. As Implied by List (2003), Players May Have Adjusted Since the Pope and Schweitzer Study, Eliminating Any Remaining Loss-Aversion:

Much has changed in the world of golf since the Pope and Schweitzer study: most notably, the extent that golf, overall, and players, individually have embraced science. The dataset that was available to these authors is available to players. And, it is now far richer in detail – covering all shots in golf, not just putting – and includes an additional decade-and-a-half of competitive data.

While players themselves may not immerse themselves in this dataset, their coaches have. It is fair to assume that all players are now aware of the improved accuracy for par putts compared with similar birdie putts. They also know, in fine-grained detail, how they compare with other tour professionals on every critical dimension in golf, including: strokes-gained-putting compared to the field; driving accuracy; driving distance; greens hit in regulation; proximity to the hole on approach shots; and par saves after missing a green; to name but a fraction of the key measurements that are available to them.

To improve in areas that stand out as weaknesses, tour players now practice with Doppler-radar tools that give them, and their ever present coaches, real-time information on every element of their shot-making including: clubhead speed, golf ball exit velocity, launch and impact angles, spin rates, distance carried, and much more – for all 14 of the clubs used in a round of golf.

And finally, most of today's best golfers grew up idolizing Tiger Woods and modelled their play after his aggressive style. They now make up the bulk of the field in top events. Anecdotally, they appear nearly fearless as

[4] Approximately 280 strokes are played in a 72-hole tournament. In the 50 events from the start of the 2019 PGA season through the first two events in a Covid shortened 2020, 27 were won by one stroke (54%); and 5 of the 27 ended in a tie after 72 holes, requiring a playoff to determine the winner.

[5] Two examples of variability in world rankings over time: Rory McIlroy was ranked 232^{nd} in 2007; 9^{th} in 2009. In 2018 Tiger Woods was ranked 1999^{th} in the world; a year later he was ranked 4^{th}.

they relentlessly attack golf courses.[6]

In light of these changes, it is fair to ask: *Are elite PGA tour golfers still loss averse?*

This question speaks directly to List's criticisms of the robustness of loss aversion in real world situations. Players today face stiff competition from other players who have spent their lives honing their skills, playing with greatly improved technologies, assisted by well-informed coaches, psychologists, dietary and exercise specialists. If experience, strong monetary and reputational incentives, and knowledge of biases are expected to eliminate loss aversion in real-world decision making, certainly performance by the top players in the world playing in the most prestigious events qualifies as an ideal domain for testing this assumption.

3. Framework for a More Transparent Loss-Aversion Study

Mistakes are nearly inevitable in a round of golf, leading to bogeys or worse. *Bogeys create naturally occurring negative-frames* that, according to Prospect Theory, should induce loss-averse behaviour. More precisely, Prospect Theory states that when a decision maker faces a risky choice *following* a loss, and thus from a negative frame, that individual is likely to act in a risk-seeking manner to reduce or eliminate the loss. *If, on the other hand, players are not loss averse they would play the subsequent hole the same regardless if it followed a bogey or not.*

This provides an opportunity to test for the presence of loss aversion among professional golfers by investigating the following hypothesis:

H1: Players make birdies more frequently on holes following bogeys.

The belief that players make a higher rate of birdies following bogeys is known, in golf folklore, as the *bounce-back effect*. Investigation into the bounce-back effect requires the tracking of individual-player performance during their competitive rounds using a *within-subject* design rather than the between-subject designs utilized by Pope and Schweitzer, and Elmore and Urbaczewski. As such, evidence of loss aversion would be grounded in the varying perceptual frames that *each* player faces during their rounds of golf.

This paper searches for evidence of a bounce-back effect by examining the individual scorecards of players competing in the 2019 U.S. Open, played at Pebble Beach, California; the 2020 U.S. Open played at Winged Foot Golf Club in Mamaroneck, New York; and at the 2019 and 2020 Masters, played at Augusta National in Georgia.

These tournaments were selected because they provide several key elements that the previous studies did not:

1. They showcase elite fields playing for the highest stakes in golf, on three of the most challenging golf courses in the world.[7]
2. These courses have fast, contoured greens, reducing the effectiveness of aggressive putting. Players were likely to restrict low-line (aggressive) putts to occasions when they were putting uphill, which acts as a control for the benefits of aggressive putting found in the Pope and Schweitzer study.
3. These recent tournaments capture the essence of modern golf, with players having access to comprehensive metrics on their performance relative to competitors. It directly tests the effectiveness of experience and knowledge as antecedents for elimination of loss aversion in real world settings.

Together, these factors create a more stringent, and transparent test of loss-aversion in real world situations by highly skilled and experienced actors performing tasks that they have honed to near perfection over their lives.

3. Empirical Analysis

The U.S. Open is the most prestigious tournament in golf, and its most demanding test. A total of 144 players began the 2019 U.S. Open at Pebble Beach. After 36 holes the field was reduced to the top 60, plus ties. Twenty

[6] Tiger Woods was the #1 ranked player in the world for 683 weeks, including consecutive weeks from 2005 through 2010; covering nearly the entire period of the Pope and Schweitzer study. During the six years of the study, Tiger played in 96 of the 239 events – he plays in only the most significant events, on the hardest courses, against the most elite fields – and yet he won an astonishing 32 of the 96 events. Tournaments typically start with ~144 competitors. An evenly distributed likelihood of winning would mean that each player has < 0.7% chance of winning. Tiger won 33% of the tournaments he entered.

[7] The top 60 players in the world qualify for the U.S. Open; the top 50 players qualify for The Masters. Winners of PGA sanctioned events in the previous 12 months qualify for both events. Major championship winners qualify for 5 years following their wins. Barring injury or some other significant interruption, all of these players enter the U.S. Open and Masters tournaments.

Augusta National was rated the 5th best golf course in the world in 2019; Pebble Beach was rated 9th. Winged Foot was rated 31st in 2020.

players tied for the 60th position. (All data publicly available on the *ESPN* Website.)

Bogey holes (bogeys-and-worse) and birdie holes (birdies-and-better) were equally plentiful. For the 79 players who made the cut and played all 72 holes of the tournament, there were 1106 birdie holes (19%), and 1093 bogey holes (19%). The essentially equal rate of birdie-and-bogey holes makes par an ideal reference point for competitors.

Against this ideal backdrop, the frequency of four, two-hole score combinations – named for easy recall – illuminates the bounce-back phenomenon. The hypothesis being tested:

Following bogey holes, players will make a higher rate of birdies.

The overall frequency of birdie holes for the tournament = 19%
The overall frequency of bogey holes for the tournament = 19%
Hot-Hand: A birdie hole followed by another birdie hole = 19%
Regression: A birdie hole followed by a bogey hole = 19%
Bounce-Back: A bogey hole followed by a birdie hole = 23% (z = 2.88; p < .01)[8]
Bogey-Train: A bogey hole followed by another bogey hole = 18%

Results show a classic bounce-back effect: After making bogey, players made birdies on the ensuing hole at a significantly higher rate (23%) than the overall rate for the tournament (19%) – providing clear evidence of loss aversion.

Results also show that the gain from the bounce-back effect was not accompanied by an offsetting loss; players made bogeys at the overall average rate following a bogey (actually a nominally lower rate of 18% v 19%). Taken together, these results suggest that player-calibration of risks improved on the holes that immediately followed bogeys.

4.1. The 2019 Masters

The Masters has been played at Augusta National since its inception in 1933. While the U.S. Open is set up to be unforgiving, with thick rough and narrow fairways, Augusta National, by comparison has almost no rough. It is meant to challenge, not overwhelm. It does however have the most contoured, fastest greens on the PGA Tour. And like the U.S. Open, it is major tournament; its prestige is roughly on par with the U.S. Open.

Sixty-five players completed the 72-hole tournament. Their cumulative score was 195 *under* par, compared with 90 *over* par at the U.S. Open reflects the more benign setup at Augusta National. For the full 72 holes, players averaged more than four strokes better relative to par at The Masters than at the U.S. Open.

The overall frequency of birdie holes for the tournament = 22%
The overall frequency of bogey holes for the tournament = 17%
Hot-Hand: A birdie hole followed by another birdie hole = 21%
Regression: A birdie hole followed by a bogey hole = 17%
Bounce-Back: A bogey hole followed by a birdie hole = 25% (z = 2.05; p < .05)
Bogey-Train: A bogey hole followed by another bogey hole = 17%

Masters results show the same pattern as those from the U.S. Open. On holes following a bogey, players again made a significantly higher rate of birdies (25%) compared to the tournament average (22%) – clear evidence of a bounce back effect – while making bogeys on the following hole at an average rate (17% v 17%). Taken together, these results show once again that player-calibration of risks improved on the holes that immediately followed bogeys. [9]

4.2. The 2020 Masters Tournament

The Masters is always played at Augusta National, which enables a direct comparison between the 2019 and 2020 tournaments. Sixty players completed the tournament with a combined score of 222 under par (195 under in 2019).

The overall frequency of birdie holes for the tournament = 23%
The overall frequency of bogey holes for the tournament = 17%

[8] To facilitate a quick visual comparison, the overall averages provided above are rounded to the nearest percent. The single-sided z-test for the 2019 U.S. Open was performed by comparing the exact percentage of bounce-back birdie holes (22.6%) with the exact percentage of all other birdie holes (18.7%). These two groups are complements. Combined they equal the overall average (19.4%).
All subsequent z-scores have been calculated in this manner.

[9] The single-sided z-test for the 2019 Masters was performed as before by comparing the percentage of bounce-back birdie holes (25%) with the percentage of all other birdie holes (21.6%). Combined they equal the overall average (22.1%).

Hot-Hand: A birdie hole followed by another birdie hole = 22%
Regression: A birdie hole followed by a bogey hole = 14%
Bounce-Back: A bogey hole followed by a birdie hole = 27% (z = 2.82; p < .01)
Bogey-Train: A bogey hole followed by another bogey hole = 17%

Results show strong support for a bounce-back effect. On holes following a bogey, players made a significantly higher rate of birdies (27%) compared to the tournament average (23%) while making bogeys on the following hole at an average rate (17% v 17%). Taken together, these results show once again that player-calibration of risks improved on the holes that immediately followed bogeys.[10]

4.3. Combined 2019 and 2020 Masters Results

The 2019 and 2020 tournaments were statistically very similar in spite of the seasonal differences – the 2020 tournament was delayed due to COVID – and the lack of spectators in 2020. Combining these results strengthens their significance.

The overall frequency of birdie holes for the tournaments = 22%
The overall frequency of bogey holes for the tournaments = 17%
Hot-Hand: A birdie hole followed by another birdie hole = 21%
Regression: A birdie hole followed by a bogey hole = 15%
Bounce-Back: A bogey hole followed by a birdie hole = 26% (z = 3.43; p < .001)
Bogey-Train: A bogey hole followed by another bogey hole = 17%

Results show very strong support for a bounce-back effect. On holes following a bogey, players made a significantly higher rate of birdies (26%) compared to the tournament average (22%) while making bogeys on the following hole at an average rate (17% v 17%). Taken together, these results show again that player-calibration of risks improved on the holes that immediately followed bogeys.[11]

4.4. The 2020 U.S. Open

The 2020 U.S. Open was played at Winged Foot Golf Club in New York, an iconic course that has hosted six U.S. Opens over the last 100 years.

Winged Foot is a diabolically difficult golf course, with brutally long-and-thick rough, narrow fairways, and severely sloped, fast greens. Scores reflected this. Sixty-one players completed the tournament. Only the winner posted an under-par score for the full tournament. The cumulative score for those finishing the tournament was a whopping 714 *over* par, an average of nearly 12 over par for each player.

The overall frequency of birdie holes for the tournament = 14%
The overall frequency of bogey holes for the tournament = 28%
Hot-Hand: A birdie hole followed by another birdie hole = 12%
Regression: A birdie hole followed by a bogey hole = 30%
Bounce-Back: A bogey hole followed by a birdie hole = 15% (z = 0.98; p = 0.16)
Bogey-Train: A bogey hole followed by another bogey hole = 29%

Bounce-back results are directionally consistent with previous results (15% v 14% overall) but do not reach significance. Bogey-train scores are directionally inconsistent with previous results but also not at a significant level (29% v 28%).

Three of the four tournaments (2019 U.S. Open and both the 2019 and 2020 Masters tournaments) show a statistically significant bounce-back effect without a correspondingly higher rate of bogeys following bogey holes, suggesting that players were better calibrated with respect to risk-taking following a bogey hole in these events. The shift in risk taking that follows a bogey was not as productive at Winged Foot, with the nominal gain in birdies roughly offset by a correspondingly higher rate of bogeys. However, this may be evidence of a difficult golf course frustrating player efforts to bounce back rather than an indicator of players not trying to do so.

Overall, the evidence is clear: bogey holes stimulate a strong loss-averse response – more aggressive play that produces a higher birdie rate and an unchanged bogey rate – in most but not all instances.

[10] The single-sided z-test for the 2020 Masters was performed as before by comparing the percentage of bounce-back birdie holes (26.7%) with the percentage of all other birdie holes (21.7%). Combined they equal the overall average (22.5%).

[11] The single-sided z-test for the combined 2019 & 2020 Masters was performed as before by comparing the percentage of bounce-back birdie holes (25.8%) with the percentage of all other birdie holes (21.7%). Combined they equal the overall average (22.3%).

Additional work would help to delineate this effect. But that is a question of importance for golfers; not decision theorists. For economists the critical result is that the feeling of loss from a reference point (par) induces loss aversion in the most elite professional golfers, not in one-off lab experiments, but in an activity repeated thousands of times, for very high stakes by experienced players whose livelihood depends on them playing at their best.

5. Discussion

This study provides strong disconfirming evidence to List's findings (2003) that with repeated decisions loss aversion in significant, real-world decision making goes away as decision makers learn from their experiences.

This within-subjects study tracked individual player performance longitudinally over their competitive rounds at the 2019 and 2020 U.S. Open and Masters Golf Championships. Loss aversion was naturally induced by the negative-framing that occurred following scores of bogey-or-worse. Players made more birdies on holes immediately following bogeys. *Had they not been loss averse, they would have made birdies at the same rate as for the tournaments overall.*

These were elite players, informed by modern analytics, performing activities they had honed through years of practice and competition, playing three iconic golf courses in the world's most prestigious tournaments. The advantages of aggressive putting, the foundation of the loss-aversion finding in the earlier Pope and Schweitzer study, were controlled by the fast, contoured-greens at Pebble Beach, Augusta National and Winged Foot. Yet in spite of the inclusion of these more stringent elements, findings from this study reveal significant evidence of loss aversion.

As suggested in Prospect Theory, it is the change in reference state that precipitates loss aversion. Having experienced the recent feeling of loss from a bogey, players value a potential loss-eliminating birdie more, momentarily increasing their risk-tolerance to achieve it. In lay terms, players threw bits of caution to the wind, to recoup their loss.

The increase in birdies following bogeys – absent an offsetting increase in bogeys in three of the four tournaments (2019 U.S. Open and the 2019 & 2020 Masters) – also suggests better player-calibration of risks and rewards followed bogeys. Reasons for this improved calibration are likely to include adjustments across the list of risk-averse behaviors detailed earlier, brought on by the loss from making bogey.

But even in these three tournaments, this improved calibration was short-lived; after making bounce-back birdies, the hot-hand data shows a return to normal scoring averages. This speaks to an important element of Prospect Theory: the notion that negative framing occurs because decision makers do not immediately reset their frames to normal after experiencing a loss.

How best to reconcile the differences between this study and List's Sports Memorabilia study? Perhaps in the end it is not so much that experience enables professional sports-memorabilia traders to overcome their reference-dependence but that their reference states are different from casual sports-memorabilia traders. Arguably, professional traders are trading to make a living; hence they view the trade of a card as a gain rather than a loss because it is a necessary activity that they do to support themselves; whereas for casual traders – those trading who are not in the business – giving up a card is a real loss, not just giving up a card from inventory, because holding the card provides utility. Accordingly, casual traders would hold out for a higher price.

5.1. Closing Comments

Elite professional golfers routinely talk about the importance of staying in the moment during a round of golf: focusing on each shot, one at a time, to the best of their ability, without being distracted by high stakes or their scores on previous holes. And yet evidence from this study suggests, that in spite of best efforts, staying in the moment is a daunting challenge.

But while focus is undoubtedly an essential element in the execution of quality golf shots, the notion of staying-in-the-moment may be exactly the wrong way to reduce loss aversion in golf. Kahneman and Lovallo (1993) highlighted the problem of too narrow a focus when decisions are viewed in isolation; "a decision maker who is risk averse in some situations and risk seeking in others ends up paying a premium to avoid some risks, and a premium to obtain others" (p 19). Perhaps the key to reducing loss-aversion is the ability to aggregate similar shots (gambles), from the past and in anticipation of future opportunities, into a portfolio of repeated shots. "Even the most extreme risk-aversion on individual problems vanishes when gambles are considered part of a portfolio" (p. 20).

6. Appendix

***The Physics of Putting**:*

When putting, players must visualize the line the ball will travel from the putter to the hole. On a flat putting surface with no grain in the grass the ball will roll straight to the hole. But when there are contours on the green, the ball will travel a curved path to the hole, and the size of that curve is speed-dependent: Slower rolling putts will curve more

than faster rolling putts. Complicating matters further, the ball rolls faster immediately after being hit, and slows over the length of the putt, meaning that contours closer to the hole will have greater effect.

Correctly 'reading' a putt requires an accurate estimate of a curvilinear function with two interactive variables: speed and break. Optimal solutions require finding one of the correct combinations between these variables. Correct combinations fall between a softly hit putt anticipating more curvature (the high-line), and a firmly hit putt with less curvature (the low-line).

Hitting putts softly has two significant advantages: First, it effectively increases the size of the hole; a ball rolling slowly can fall into the hole from the edges. A fast-rolling putt can only go in if hit near the centre of the hole.

And second: A ball hit at dead-weight, at a speed that will cause a missed putt to stop only a very short distance from the hole, leaves an easier follow-on putt to complete the hole.

Counter-intuitively, players typically hit putts more aggressively when they are *unsure* of the break. Doing so, for example on a 3-10 foot putt, will reduce or eliminate the break so it is actually the safer choice when uncertain: You'll make that putt more often than you'd make a misread putt hit softly. And if you miss that firmly hit putt, even though the ball rolls further beyond the hole, the player has learned the break for the return putt because he watched the arc of his ball as it rolled past the hole.

From this analysis, one can see that optimal putting-performance is tied to the context of the specific putts and is more about players actively managing their uncertainty. The notion that more aggressive putting would lead to better scores is … too linear.

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