"Another One Bites The Dust": Peer Effects and Motivation in High Level Performers

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Abstract

In this paper we investigate whether a corner assignment itself can change the odds of wins and losses. We gather information on fight statistics, bets, and fight purses for more than 4,000 fights that took place as part of Ultimate Fighting Championship (UFC) between 1993 and 2020. By generating a panel database of fighter rankings, we find that "underdog" fighters win at a higher rate if they are assigned to Red Corner on fights they should have been assigned to Blue Corner.

JEL Codes: D84, D91, G14, J0, M51, M52, Z2

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1 Introduction

It is well documented that motivation affects outcomes (Canice Prendergast, 2007, 2008; Christiane Bradler, Robert Dur, Susanne Neckermann and Arjan Non, 2016). From the perspective of a manager, acknowledging the performance of a promising team member could give a substantial boost on their effort (Christopher Orpen, 1997; Weihui Fu and Satish P. Deshpande, 2014). Similarly, showing lack of full confidence on a team member could create strong demotivating effects (Sarah Brown, Daniel Gray, Jolian McHardy and Karl Taylor, 2015; Lea Ellwardt, Rafael Wittek and Rudi Wielers, 2012; John T. Addison and Paulino Teixeira, 2020).

Moreover, evidence on peer-effects among team members is documented in studies using settings ranging from analyzing golf players to grocery store employees (Alexandre Mas and Enrico Moretti, 2009; Jonathan Guryan, Kory Kroft and Matthew J. Notowidigdo, 2009; Eric D. Gould and Todd R. Kaplan, 2011; Marie Claire Villeval, 2020). Firms can potentially benefit from forming groups in which the higher skilled and more experienced employees provide support to newly introduced team members, resulting in positive productivity spillovers.

In this paper we investigate whether a "signal of confidence", directly and through peer-effects of other similarly signaled fighters, can change the course of outcomes. We gather information on corner assignments from more than 4,000 fights that took place as part of Ultimate Fighting Championship (UFC), a mixed martial arts promotion, between 1993 and 2020. To control for fighter ability, we create a database of fighter ratings similar to the Elo rating system used in chess. Gathering information on detailed fight statistics, bets, and purses, we find that "underdog" fighters are likely to win their matches more if they are assigned to Red Corner on fights they should have been assigned to Blue Corner. This works against the expectations of fighter ratings and bets markets for these particular cases. We verify that the Red Corner advantage persists in fights between similar-ability fighters. We rule out an evolutionary color effect explanation by collecting information on fighters' trunk colors.

The effect of color on performance has been investigated in various settings. Russell A. Hill and Robert A. Barton (2005) report that in the 2004 Olympic Games, contestants who wore red in four combat sports (boxing, tae kwon do, Greco–Roman wrestling and freestyle wrestling) had more wins compared to contestant wearing blue. Hill and Barton (2005) attribute this result to the

influence of color red on human mood and aggression. Using an experiment, Dennis Dreiskaemper, Bernd Strauss, Norbert Hagemann and Dirk Büsch (2013) show fighters on the Red Corner have higher heart rates and that body functions of the contestants are influenced by wearing red color. The red color effect seems to exist for rugby players (Marco Piatti, David A Savage and Benno Torgler, 2012) goalkeepers in soccer (Iain A. Greenlees, Michael Eynon and Richard C. Thelwell, 2013) and even in computer game competitions (Andrei Ilie, Silvia Ioan, Leon Zagrean and Mihai Moldovan, 2008).

On contrary to Hill, Norbert Hagemann, Bernd Strauss and Jan Leißing (2008) show evidence that findings in Hill and Barton (2005) could be due to referee's bias than an effect on the contestant. Hagemann, Strauss and Leißing (2008) ask a group of tae-kwon do referees to score video recorded fights. Colors for the contestants in these fights were randomly changed with post-video editing. They show evidence that referees systematically favored the fighter wearing red. Moreover, a set of papers show findings Hill and Barton (2005) is not robust. Roberts SC. Rowe C, Harris JM (2005) use the same 2004 Olympic Games and find that results in Hill and Barton (2005) are not robust to Judo competitions.[1] Charles Seife (2012) extends the previous analysis using 2004 Olympics observations to 2008 Olympics and show no evidence of differences in outcomes and fighter colors. More work exists showing the color itself has little to no impact on performance, but rather the confounding factors are the main drivers of the association between higher win rates and the color (Mark S. Allen and Marc V. Jones, 2014). In a closer setting to our work, Thomas V. Pollet and Leonard S. Peperkoorn (2013) test the "color effect" in UFC fights. They obtain trunk color information for 210 fights and conclude that wearing red trunks does not have any significant impact on fight outcomes. We implement a similar analysis using our sample of UFC fights. Collecting information on trunk colors for 600 fights, we indeed document that a "color effect" exists, albeit with a modest impact. Our results show that the player who sees the red color on their opponent scores more wins. Similarly, a player who wears red trunks loses more often compared to his games wearing any other color.

The remainder of our paper is outlined as follows: Section 2 provides a background on UFC.

[1] Peter D Dijkstra and Paul T.Y Preenen (2008) show that corner assignment in Olympic judo competitions is non-random thus need to be accounted for. In such competitions, however, there is no variation in the corner color and color worn by the fighters hence they conduct their analyses via restricting their sample to different stages of the tournament in an attempt to account for the ability gap.

Section 3 gives information on the data collected and constructed. Section 4 outlines the empirical methodology. Section 5 presents the results. Section 6 includes robustness checks. Section 6 concludes.

2 Background: Ultimate Fighting Championship

UFC is a mixed martial arts (MMA) promotion founded in 1993. Unlike other popular combat sports, it allows fighters to utilize numerous styles and techniques. It is the largest MMA promotion in the world in terms of fan base, revenue, and value.[2] This strength allows them to recruit the most highly rated talent in the business.[3]

2.1 Corners

In fighting sports, including UFC, fighters begin their bouts fighting out of a particular corner, with the corner denoted by color, either red or blue. Originally, many fighting sports, such as boxing fought outdoors.[4] The corner a fighter fought out of was therefore of great importance; if a fighter is facing the sun, they may have more difficulty seeing their opponent coming. Due to this disadvantage, corners were chosen at the time of the fight by a coin flip (Thomas Hauser, 2019). During the 1980s, however, television networks wanted the favored fighters to sit in certain corners for visibility. Now, favored fighters are placed in the "red" corner, and the underdogs fight out of the "blue" corner.

Match-ups and the corner placement are decided by two UFC matchmakers Joe Silva and Mick Maynard.[5] As a private promotion, UFC is free to set up any fight between two fighters as long as fighters agree on the terms. Typically matchmakers consider the potential popularity of a given fight which maximizes fan entertainment. The "favorite" fighter is then assigned to Red Corner and the underdog to the Blue Corner. The definition of favorite is vague in the sense that there is no specific metric (such as Elo ratings in chess) to determine the favorite fighter. Hence it can

[2] Fan base size being measured by social media "likes."

[3] According to www.cbssports.com, nine out of ten of the best MMA fighters of all time fought for UFC at some point.

[4] The authors conducted an interview with sports writer Thomas Hauser to get background information on corner assignment in fighting sports, specifically, boxing.

[5] Sean Shelby, who worked as a matchmaker at UFC with Joe Silva retired and was replaced by Mick Maynard in 2016.

be expected to have inefficiencies in the corner assignments due to not having a standard universal ranking system.[6]

Corner assignment matters for several reasons. First, since corner assignment is based on expectations of victory, this can impact the mental state of the fighter. This effect could be direct, simply from knowing the fight expectation, or it could come from peer effects. When a fighter is assigned to a corner, they are grouped with fighters of their own corner color for scheduled logistics, such as sharing the same locker room or busing to the event. Imagine being a fighter, expected to lose, surrounded with other fighters expected to lose. Sports writer Thomas Hauser notes that "blue" locker rooms are often "dreary places." Finally, there could be other advantages to "red" assignment. For example, the "red" corner gets assigned the most experienced "cutmen" to dress wounds in between rounds. In Section 6.3, we investigate the degree to which "cutmen" can affect outcomes.

3 Data

Our data comes from multiple sources. The main source is the official fight statistics published by UFC.[7] We obtain every official UFC match published that took place between November 1993 and March 2020. These data includes detailed fight-level and player-level information such as the corners, number of hits attempted, number of hits landed, and outcome of the fight. We link this data to bets data scraped from (name of the bets website). These data includes opening and closing spreads, i.e. the spread when the fight pairings are announced by UFC and the very last spread available on the day of the fight night. Lastly, we link the fight purse data scraped from www.thesportsdaily.com.

3.1 Fight Statistics

For each fight, UFC publishes detailed fight-level performance statistics such as the total number of strikes attempted and landed, the portion of strikes landed on opponent's head, body, or leg. Player-level characteristics include height, weight, and reach of a player, age, dominant fighting

[6] UFC has an official ranking for only the top 15 fighters. These rankings are determined via a voting panel made up of media members.

[7] These statistics can be accessed at www.ufcstats.com.

technique at the time of the fight. Further fight-level characteristics include the name and location of the event, number of attendees at the event, bout type, names of the referees and judges. In terms of the outcomes, the result of the fight is included specifically listing when (measured in seconds between the start and end of the fight) and how a fight has ended: e.g. a technical knockout, decided by judges, or ended in a submission. In addition, these data include specific descriptions on the ending such as "kick to head at distance" or "guillotine choke from guard."

3.2 Elo Ratings

Many sports have an official rating system where each player (or a team) is ranked according to the wins and losses they had accumulated up to a contest. One of the most popular of such systems is the Elo ratings used in chess. With such rating system, it is possible to assign a probability on the outcome of a contest using the pool of past performances up to the contest.

Suppose two fighters, fighter R who fights in the Red Corner and fighter B who fights on the Blue Corner compete in a fight. The outcome of a fight is a win, draw, or a loss. Assuming each fighter's performance on a given night, p, is a random draw from a normal distribution centered around the true level of performance, the probability that fighter R wins is a function of Elo ratings of both fighters,

$$\begin{aligned} P(p_R > p_B) = P(p_R - p_B > 0) &= \int_0^\infty \frac{1}{\sqrt{2\sigma^2}} \Phi\left(\frac{x - [\mu_R - \mu_B]}{\sqrt{2\sigma^2}}\right) \, dx \\ &= 1 - \Phi\left(\frac{0 - [\mu_R - \mu_B]}{\sqrt{2\sigma^2}}\right) = \Phi\left(\frac{[\mu_R - \mu_B]}{\sqrt{2\sigma^2}}\right) \end{aligned} \tag{1}$$

where $\Phi(.)$ is the c.d.f. for the normal distribution. Assume the common variance is $\sigma^2 = (\frac{2000}{7})^2$, the expected outcome of a fight becomes

$$E\left(S_R \mid R_R, R_B\right) = \Phi\left(\frac{R_R - R_B}{400}\right) \tag{2}$$

where S_R is the actual outcome for fighter R. That is, if fighter R wins then S_R (similarly, $S_R = 0$ if he loses). R_R and R_B are the ELO ratings (at the time of the fight) for fighters R and B,

respectively. Once an outcome is realized, ratings are updated with the rule

$$Rating_{R,t+1} = Rating_{R,t} + K\ [S_R - E_t\left(S_R \mid R_R, R_B\right)] \tag{3}$$

where K is a constant for rate of adjustment. Following this strategy, we create a database of fighter ratings that assigns fighters an initial rating on their debut fight, and update them according to (3) with each fight. Figure 1 compares the current standings published by UFC and our ELO rating estimations for top 10 fighters.[8]

3.3 Bets

UFC's popularity as a combat sport has generated a large betting community. Similar to other sports, it is possible to bet on the outcome of a match using online betting platforms. Opening bet odds are published by each oddsmaker after the announcement of the matchups by UFC. Bets are closed on the fight night. We obtain opening and closing bet odds from www.bestfightodds.com available for more than 3,500 fights. Using expectations from the bets market, we can determine which fighter before the fight night is the favorite fighter, thus should receive the Red Corner per the bets market.

3.4 Random Forest

While we assume that the betting market for UFC is thick based on its popularity; however, for completeness, we also include measures of the corner decision process using a machine learning algorithm with features based on all available information in a fighter's history.[9] To accomplish this, we use a random forest: we generate a bootstrapped dataset where numerous decision trees are grown using a random selection of features at each node. Each tree "votes" on if the fighter is expected to win or lose. These trees are first created using a sample of the overall dataset and tested against the rest to produce the desired output. In our case, we want the model to not

[8] Official UFC rankings use popularity and viewer votes rather than a standard rating system such as Elo ratings.

[9] A sample of features used for random forest: Fighter, opponent, date, location, if the fight was a title bout, what weight class the fight is, number of rounds, winning streak, losing streak, draws, average attempts for clinch hits [where fighters are grappled in a standing position], average clinch hits, average body attempts, average body hits, average distance attempts, average distance hits, average attempts on the ground, average hits on the ground, average strikes judged to be "significant" landed, opponent wins by doctor stoppage, experience measures such as total time fought and total rounds, and many more.

take into account future knowledge, thus we limited the training set to fights that occur prior to an individual fight. The next fight would include the previous training set plus the prior fight. Because early fights would not have the benefits of many prior observations we set the first testing sample to be the first fight of 2010, 17 years after the first UFC fight. In our analysis, we utilize both the overall expectation on if the random forest expects a fighter to win, as well as the percent of votes differential between the fighters.

3.5 Purses

The pay for UFC fighters, or purses, come from multiple factors. Fighters are paid per fight and the amount depends on how good of a draw the fighter is, sponsorships, event size, and performance. The performance incentives include a win bonus, performance of the night bonus, fight of the night bonus, and formerly, knockout of the night and submission of the night bonuses. These bonuses are often in the tens of thousands of dollars. For example, the performance of the night bonus is $50,000. These performance incentives do not change much over time and do not change based on the popularity of a fighter, thus the bonuses may be many times the payout to show for less established fighters, some of whom make as low as $3,000. They may be a drop in the bucket for fighters such as Conor McGregor whom has earned $3,000,000 just for showing up. Data on purses is limited as most states have, at some point, moved to consider purse data as confidential.

3.6 Performance Enhancing Drugs (PED) Cases

The use of performance-enchancing drugs (PED) has been an issue in many sports, including UFC. There have been numerous cases in which a fighter is tested positive for banned substances. We obtain a list of UFC fighters who were caught with a PED since 2015 from the U.S. Anti-Doping Agency (USADA). In a given number of fights, these fighters potentially performed better than their expected performance due to substance use. What is more, the substance use can act as a catalyst which could potentially amplify the effect of being on Red Corner.

Moreover, bet odds are published as a time-series for each fight with the first observation being the opening bet odds and the last observation closing odds. Figure 2 shows a histogram of the difference in fighters' opening and closing bet odds. Green bars show that on average, bet odds do

not change significantly over time for a fighter.[10] However, blue bars show when a fighter who was convicted at least once in their career due to their use of PEDs have odds favoring them towards the fight night. In other words, there are instances in which a PED fighter was announced the underdog in the opening bet odds and with bet market's demand adjustments, they become the favorite before the fight night.

4 Empirical Methodology

We start from the following baseline specification which checks the differences in win rates between Red Corner and Blue Corner for all fights,

$$Win_{i,j,k} = \beta_0 + \beta_1 \, Red_{i,j,k} + \boldsymbol{\Psi X_{i,j,k}} + \eta_i + \nu_j + \tau_k + \epsilon_{i,j,k} \tag{4}$$

where $Win_{i,j,k}$ is an indicator equals 1 if fighter i wins against fighter j in fight k. $Red_{i,j,k}$ equals one if Player i fights in Red Corner against fighter j in fight k. $\boldsymbol{X_{i,j,k}}$ includes controls such as "opponent quality", event location, event attendance, η_i is player fixed-effects, ϵ_i is the idiosyncratic shock.

A result showing $\beta_1 > 0$, can be potentially due to two reasons (i) Being on Red Corner gives you an advantage over your opponent, (ii) Players who are assigned to Red Corner are "higher ability" fighters in the first place. Thus running (4) would give biased estimates due to higher ability fighters selecting into Red Corner.

One way to control for the ability effect is to create a process that assigns players to their "deserved" corners on the basis of "player quality at the time of the fight" and find the "undeserved" assigments, that is

Assignment Rule 1. *If Ability of Fighter X > Ability of Fighter Y (at the time of the fight) then Fighter X gets assigned to Red Corner.*

If this condition is not satisfied, then the corner assignment is *undeserved* such that the underdog fighter is assigned to Red Corner (against tradition). If the weaker fighter still secures more wins being on Red Corner, this would provide evidence on the "color effect", independent of ability.

[10] Or, it shows the gains and losses in the advantage are equivalent and symmetric in the whole sample.

One approach to measure player quality is to use "net wins" i.e. $wins - losses$ for each player at the time of the fight. However this approach has two problems (i) It is possible to have fighters with similar net wins, but against different skilled opponents in their record (ii) It is difficult to distinguish two fighters with similar net wins and different levels of wins and losses.

Arguably, a better approach is to use a ranking system similar to Elo rankings in chess. Each player gets a starting Elo rating at the beginning of their career. As they progress in their career, their rating changes are calculated via equation (3) with each fight. Following this, the assignments become

Assignment Rule 1.1. *If Elo rating of Fighter X > Elo rating of Y (at the time of the fight) then Fighter X gets assigned to Red Corner.*

In addition to fighters' Elo ratings at the time of the fight, we use information from the bets markets to further determine which of the fighters has a higher expected win via

Assignment Rule 1.2. *If Elo rating of Fighter X > Elo rating of Y and Fighter X is the bets favorite (at the time of the fight) then Fighter X gets assigned to Red Corner.*

Using these assignment criteria, we identify "off cases" in which an underdog fighter is assigned to Red Corner. In these fights, according to expectations from both Elo ratings, and bets market expectations, the underdog fighter has less chances for victory. We can test if the opposite is observed in the data via the following specification

$$Win_{i,j,k} = \beta_0 + \beta_1 \, BetterAssignment_{i,j,k} + \boldsymbol{\Psi X_{i,j,k}} + \eta_i + \nu_j + \tau_k + \epsilon_{i,j,k} \tag{5}$$

where $Win_{i,j,k} = 1$ if fighter i wins against fighter j in fight k. $BetterAssignment_{i,j,k} = 1$ if the underdog fighter is assigned on Red Corner instead of Blue Corner.

As an alternative specification, we check if color assignments matter in fights with similar-ability fighters via a setup that takes into account the distances in ability between each fighter. For this, we estimate (4) and restrict the ability differences to smaller bandwidths of elo rating difference, bet expectation difference, and expectation difference of random forest votes. For such fights between close ability fighters, we expect no significant differences in win rates to any of the corners, unless there is a significant edge a fighter can enjoy with being on the Red Corner.

Table 1 shows the summary statistics for all sample, and the sample restricted to Red Corner and Blue Corner fighters. According to our Elo rating calculations, Red Corner fighters have higher Elo rating on average than the Blue Corner fighters. Similarly, Red Corner fighters are more often the bet favorites. And our machine learning methods estimate Red Corner fighters to be more likely to be the winners. The last three rows show the proportion of "off cases" where an underdog fighter is assigned on Red Corner using each of our assignment methods. Table 2 presents the confusion matrices for each assignment method. Each matrix contains the count of underdog and topdog fighters who should receive the Red Corner obtained via each assignment method, and their proportion of actually receiving the Red Corner. 64% of the Red Corner fighters had the higher ELO rating; 70% were the bet favorites; and received 92% of the random forest votes predicting the stronger fighter. Each proportion being larger than 50% does indeed imply the stronger fighters get the Red Corner. Moreover, it shows there are "off cases:" 36% of Red Corner fighters were ELO underdogs; 30% bet underdogs and 8% random forest underdogs. We will focus on these particular cases in the next section.

5 Results

We start by verifying that fighters on the Red Corner indeed secure more wins. Table 3 shows the simple correlation between fighting out of Red Corner on win rates. A fighter on the Red Corner has a 32 percentage points higher probability of victory compared to a fighter on Blue corner, controlling for (controls). As discussed in the previous section, this estimate cannot be interpreted as causal, due to higher ability fighters selecting into Red Corner. We then check if the differences in ability is the only driver of this estimate, or receiving Red Corner itself changes the outcome of a match.

On Tables 4-6, we report the baseline specification to fights fought between fighters with similar expected win probabilities before the fight per their ELO ratings, bet expectations and expectations obtained via our machine learning algorithms. In fights with similarly rated players in terms of ELO ratings, Red Corner fighters still manage to score more wins. They secure $30-36$ percentage points more wins in Red Corner against similar ranked opponents compared to their games against similar ranked opponents fought out of Blue Corner. Results from bet expectations and machine

learning algorithms also document the edge for the Red Corner fighters. The magnitude of the win rate difference with these methods is documented at a range of $5-22$ percentage points.[11]

Tables 7-9 show the performance of underdogs who fought out of Red Corner. They appear to secure more wins according to all our assignment criteria with magnitude ranging $5-18$ percentage points. These fighters are expected to lose to their opponents before fight however they seem to perform above expectations indicating that corner assignment itself influences on the outcome of a fight. Column (5) checks how underdogs performed at their "debut." If they are given Red Corner, they seem to perform extraordinarily documented with stronger magnitudes of the coefficient. Column (6) presents the coefficient estimated with the experienced fighters, who have at least 3 fights in their career at the time of the fight. They also appear to benefit from being on Red Corner.

Lastly, we observe fighters who were convicted with PED use benefit more greatly from being assigned to Red Corner as an underdog. Column (7) documents the effect of being on Red Corner against a stronger opponent for fighters with PED experience at any point in their career. The effect is about two times stronger with ELO rating assignment alone; five times stronger when bets are introduced; and 20% stronger when random forest votes are taken into account. What could explain these stronger magnitudes? One driver for these results could be that PED usage could act as a catalyst for the Red Corner effect. Motivational effects could potentially be realized more strongly with the help of PEDs.

6 Robustness Checks

6.1 Fighter Clothing

To test the hypothesis of "color-effect" proposed in earlier studies, we collect information on fighters' trunk colors for 1200 fighters in 600 fights. With individual searches for images from the each fight, we identify the fighters and record the color of their trunks worn. We observe 156 fighters with blue trunk and 131 fighters wearing red trunk. The remaining fighters wore black, gold, green, grey, white, and yellow. Counts on each color are presented in Table 10. We then check if a behavioral response exists due to Red color raising aggressiveness from any of the sides in

[11] Restricting the sample to fighters with at least three fights at the time of the fight gives similar results with results presented in Tables 18-20 in the Appendix.

Tables 11-12. It appears in all specifications, wearing red trunk is associated with lower chances to win, and seeing red trunk on the opponent is associated with increased chances of win, albeit with imprecise coefficients. On average, wearing red decreases chances to win by about 10 percentage points while fighting against an opponent wearing red increases chances of win by approximately $0.7 - 3.7$ percentage points. While the magnitudes of these coefficients are not as strong to explain the Red Corner advantage, we believe our results on trunk colors do indeed fit within the hypothesis of behavioral responses due to perception of color.

6.2 Assessing Heterogeneity in Purse Values

Incentives and prizes are well documented to have an effect on performance in contests. (Edward P. Lazear and Sherwin Rosen, 1981; Ronald G. Ehrenberg and Michael L. Bognanno, 1990; Bentley Coffey and Michael Maloney, 2010). Could it be possible that the motivation effect enjoyed via being on Red Corner is stronger for fights with higher stakes? We test our main specification for low and high purse fights. Tables 13-14 presents the Red Corner difference in win rate split with low and high purse fight samples. We observe stronger underdog momentum with Red Corner in low purse fights. This results implies a disincentive effect on the topdog fighter fighting out of Blue Corner. It could be that the prize incentive is not as strong for the topdog fighter than the underdog fighter fighting out of Red Corner.

6.3 Cutmen: A Possible Other Advantage To Red-Corner Assignment

A "cutman" is a person trained in first aid, though not a doctor, that treats wounds between rounds and prepares handwraps if requested, prior to the fight. Treating these wounds are integral to avoid defeat as if they are not quickly and properly treated, it could impair a fighter's ability to see. If this occurs, a referee will stop the fight and the opponent will be awarded the victory.

Anecdotally, we believe there may be reasons to expect Red Corner fighters −being the house favorite− to receive more skilled cutmen. For instance, in an interview, famous cutman Jacob "Stitch" Duran (Jon Gelber, 2013) states that while he tries to keep his "neutrality" in terms of which corner he is assigned to, he typically ends up in the Red Corner. Of course, the assignment of cutmen could be a problem only if the skill level difference between the experienced cutman in the red corner is sufficiently different from that of the Blue Corner cutmen systematically, so that

it could affect the outcome of the match.[12]

If this is the case, then a fighter assigned to the red corner with the experienced cutman has both a psychological advantage and the advantage of better care in between rounds, with the latter possibly directly affecting the result of the match and thus bias our results upward. We investigate the extent to which this is a problem in this section. In Table 15, we show the frequency of red corner assignment and winning strictly due to a cut.[13] There are two things of import we can get from this table. First, it is clear that the red corner fighter overwhelmingly wins their fights. Second, the number of fights won via decision due to cuts is very small.

Tables 16-17 test whether cutmen could be the main driver of the Red Corner advantage. It appears cutmen have a small positive impact on the outcome. Absence of cutmen effect, we expect no differential increase in the fight outcomes won via cutmen. The coefficent of 0.006 indicates Red Corner fighters have 0.06 percentage point more wins ended due to a cut. A cutman's impact is most likely too small to explain the Red Corner edge.

7 Conclusion

Motivation in the workplace is a significant concern for firms. By showing full-confidence on their workers, could firms observe performance benefits? We find that it is indeed possible to change the course of outcomes by showing confidence on a tournament participant by using observations from UFC fights. Fighters fight out of two corners: Red and Blue; with Red Corner designated for the stronger player. To control for player strength, we use three main methods. (i) Construct a database of ELO ratings similar to the official ELO ratings used in many other competitive sports such as chess (ii) We obtain bet odds information for each fight showing the favorite fighter (iii) We construct a state-of-the-art machine learning algorithm which predicts the better fighter using information from both the fighter's history, as well as, outcomes of similar-performing fighters.

[12] "Stitch" goes on to mention an anecdote that support the idea of some cutmen being better than others: *"I have tons of stories from guys and we're talking about the importance of a cutman. When B.J. Penn fought Joe Stevenson, I think we were in England, I was working B.J. Penns corner and Joe Stevenson ended up with a big old gash between his eyes. He's bleeding like a pig and we stopped the fight. And in the dressing room, his trainer is telling me now after the fight in the dressing room Joe was saying, 'Where was Stitch? Where's Stitch?' And those guys kind of look up to what we do. I think, especially of all the cutmen, they have a lot of confidence in me and that was just a nice little gesture. It was nice that he made that kind of comment."*

[13] Winning via a cut may not be a perfect measure of how effective a cutman is due to the nature of randomness of cuts. For instance, a fighter could lose the fight due to a cut received during the same round, which would be no fault of the cutman.

Our results show that in fights fought between two fighters with very close strength, Red Corner fighter still ends up winning significantly more on average. What is more, even if a fighter is considered weaker, putting him on Red Corner raises his probability of winning the fight. These results cannot be explained by Red Corner fighters enjoying better support during fight via having the support of more skilled cutmen, nor could be attributable to a behavioral response color red itself raising aggression from any of the sides. We believe that results can be due to (1) the organizer of the fights showing full confidence on a fighter even though his past record is weaker than his opponent's or bet market thinks his chances of victory is not high. (2) It is not uncommon for Red Corner fighters to have a "club" where they train or discuss fights together, potentially benefiting from other Red Corner fighters with a longer tenure.

Our suggestion for firms is simple. They should let their employees be aware that they show full confidence in them. Showing such confidence can give a significant boost in their performance, enabling them to solve tasks that perhaps could not have been solved in absence of such motivation effects. What is more, providing an environment where employees can train together and exchange their ideas can provide further benefits, raising productivity in the workplace.

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Tables

Table 1: Summary Statistics

	All		Red		Blue		Difference	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Difference	t-statistic
Elo Score	1,522.988	36.185	1,528.181	38.647	1,517.795	32.734	-10.386***	(-14.185)
Better Corner (Elo)	0.182	0.386	0.364	0.481	0.000	0.000	-0.364***	(-52.309)
Better Corner (Bet)	0.119	0.323	0.237	0.425	0.000	0.000	-0.237***	(-38.570)
Better Corner (Random Forest)	0.041	0.199	0.083	0.276	0.000	0.000	-0.083***	(-17.503)
Elo Score Difference	0.000	35.443	10.386	33.889	-10.386	33.889	-20.772***	(-29.981)
Bet Score Difference	0.000	0.240	0.084	0.225	-0.084	0.225	-0.168***	(-31.872)
Random Forest Vote Difference	-0.000	0.453	0.363	0.272	-0.363	0.271	-0.725***	(-110.022)
Win?	0.500	0.500	0.675	0.468	0.325	0.468	-0.350***	(-36.553)
N	9,570		4,785		4,785		9,570	

Table 2: Confusion Matrices for Corner Assignment

	Actual Corner Assignment					
	Blue		**Red**		**Total**	
	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.
Exp. Assignment (ELO)						
Blue	2,188	64.4	1,210	35.7	3,398	50.1
Red	1,207	35.6	2,176	64.3	3,383	49.9
Total	3,395	100.0	3,386	100.0	6,781	100.0
Exp. Assignment (Bets)						
Blue	1,963	57.8	1,011	29.9	2,974	43.9
Red	1,432	42.2	2,375	70.1	3,807	56.1
Total	3,395	100.0	3,386	100.0	6,781	100.0
Exp. Assignment (Random Forest)						
Blue	3,114	91.7	281	8.3	3,395	50.1
Red	281	8.3	3,105	91.7	3,386	49.9
Total	3,395	100.0	3,386	100.0	6,781	100.0

Note: To appropriately compare the matching performance of the three variables, all samples are restricted to contain only the same sample as the random forest.

Table 3: Win rate difference between Red Corner vs. Blue Corner

	(1)	(2)	(3)	(4)
Red Corner	0.351***	0.321***	0.321***	0.325***
	(0.013)	(0.016)	(0.015)	(0.014)
Observations	9582	9582	9234	9008
Fighter FEs		X	X	X
Location FEs			X	X
Controls				X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

Controls: fighter rating, opponent rating, total hits, significant strikes %

* p<0.10, ** p<0.05, *** p<0.01

Table 4: Win Rate Difference for Fighters with Similar ELO Ratings

	(1) <45	(2) <35	(3) <25	(4) <15	(5) <5
Red Corner	0.311***	0.313***	0.307***	0.294***	0.364***
	(0.015)	(0.016)	(0.018)	(0.027)	(0.058)
Observations	7388	6392	4637	2430	600
Fighter FEs	X	X	X	X	X
Location FEs	X	X	X	X	X
Controls	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 5: Win Rate Difference for Fighters with Similar Bet Expectations

	(1) <.45	(2) <.35	(3) <.25	(4) <.15	(5) <.05
Red Corner	0.232***	0.225***	0.178***	0.051	2.741***
	(0.015)	(0.015)	(0.018)	(0.065)	(0.471)
Observations	6878	6500	4736	629	35
Fighter FEs	X	X	X	X	X
Location FEs	X	X	X	X	X
Controls	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 6: Win Rate Difference for Fighters with Similar Random Forest Votes

	(1) <.45	(2) <.35	(3) <.25	(4) <.15	(5) <.05
Red Corner	0.160***	0.132***	0.120***	0.061	0.121
	(0.018)	(0.021)	(0.028)	(0.047)	(0.185)
Observations	4193	3260	2192	1039	149
Fighter FEs	X	X	X	X	X
Location FEs	X	X	X	X	X
Controls	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 7: Win Rate Difference for Fighters ' Undeservedly ' Assigned to Red Corner According to ELO

	(1)	(2)	(3)	(4)	(5) Debuts Only	(6) Experienced	(7) PED
Better Corner (Elo)	0.183***	0.251***	0.253***	0.184***	0.415***	0.162***	0.333***
	(0.014)	(0.016)	(0.015)	(0.014)	(0.032)	(0.016)	(0.059)
Observations	9570	9570	9214	9156	1737	7452	462
Fighter FEs		X	X	X		X	X
Location FEs			X	X	X	X	X
Controls				X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

* p<0.10, ** p<0.05, *** p<0.01

Table 8: Win Rate Difference for Fighters ' Undeservedly ' Assigned to Red Corner According to Both ELO and Betting Market

	(1)	(2)	(3)	(4)	(5) Debuts Only	(6) Experienced	(7) PED
Better Corner (ELO & Bets)	-0.028	0.063**	0.070***	0.048**	0.167***	0.032	0.239**
	(0.022)	(0.027)	(0.024)	(0.023)	(0.064)	(0.025)	(0.110)
Observations	7843	7843	7589	7558	1247	6309	354
Fighter FEs		X	X	X		X	X
Location FEs			X	X	X	X	X
Controls				X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

* p<0.10, ** p<0.05, *** p<0.01

Table 9: Win Rate Difference for Fighters ' Undeservedly ' Assigned to Red Corner According to Elo, Bets, & Random Forest

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
					Debuts Only	Experienced	PED
Better Corner (By All Measures)	0.147***	0.056	0.068	0.066	0.138	0.079	0.076
	(0.056)	(0.065)	(0.062)	(0.061)	(0.177)	(0.060)	(0.163)
Observations	6332	6332	6111	6088	1002	5060	270
Fighter FEs		X	X	X		X	X
Location FEs			X	X	X	X	X
Controls				X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

This is included for completion. The random forest was very accurate and as such, there are not a large number of instances of better assignment.

* p<0.10, ** p<0.05, *** p<0.01

Table 10: Tabulation of Corner Assignment and Trunk Colors

	Corner Fought Out Of		
	Blue	**Red**	**Total**
	Freq.	Freq.	Freq.
Primary Shorts Color			
Black	184	309	493
Blue	89	67	156
Gold	0	1	1
Green	36	27	63
Grey	172	87	259
Red	74	57	131
White	5	3	8
Yellow	40	49	89
Total	600	600	1,200

Table 11: Win Rate Difference of Red Assignment, Controlling for Color

	(1)	(2)	(3)
Red Corner	0.153***		0.150***
	(0.043)		(0.042)
Fighter's Shorts Are Red=1		-0.094	-0.104
		(0.099)	(0.101)
Fighter's Opponent's Shorts Are Red=1		0.128*	0.116
		(0.073)	(0.072)
Observations	982	982	982
Fighter FEs	X	X	X
Location FEs	X	X	X
Controls	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

Controls: Age, Opponent Age, Elo Difference

* p<0.10, ** p<0.05, *** p<0.01

Table 12: Win Rate Difference of Better Assignment, Controlling For Color

	(1)	(2)	(3)
Better Corner (Elo)	0.238***		0.235***
	(0.060)		(0.060)
Fighter's Shorts Are Red=1		-0.094	-0.107
		(0.099)	(0.100)
Fighter's Opponent's Shorts Are Red=1		0.128*	0.113
		(0.073)	(0.073)
Observations	982	982	982
Fighter FEs	X	X	X
Location FEs	X	X	X
Controls	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

Controls: Age, Opponent Age, Elo Difference

* p<0.10, ** p<0.05, *** p<0.01

Table 13: Win Rate Difference for Fighters with Similar ELO Ratings: Low Purse Fights Only

	(1)	(2)	(3)	(4)	(5)	(6)
	<45	<35	<25	<15	<5	<5, Experienced
Red Corner	0.292***	0.322***	0.375***	0.295***	0.613***	0.599**
	(0.053)	(0.060)	(0.070)	(0.101)	(0.179)	(0.201)
Observations	628	527	378	189	22	20
Fighter FEs	X	X	X	X	X	X
Location FEs	X	X	X	X	X	X
Controls	X	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 14: Win Rate Difference for Fighters with Similar ELO Ratings: High Purse Fights Only

	(1)	(2)	(3)	(4)	(5)	(6)
	<45	<35	<25	<15	<5	<5, Experienced
Red Corner	0.314***	0.315***	0.314***	0.311***	0.388***	0.388***
	(0.016)	(0.017)	(0.019)	(0.028)	(0.063)	(0.084)
Observations	6691	5783	4166	2147	498	377
Fighter FEs	X	X	X	X	X	X
Location FEs	X	X	X	X	X	X
Controls	X	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 15: Tabulation of Winning Due To Cuts and Red Corner Assignment

		Red Corner		
		0	1	Total
Win (Cut)	0	4,789	4,753	9,542
	1	2	38	40
	Total	4,791	4,791	9,582

Table 16: Win Due To Cuts Rate Difference for Fighters Assigned to Red Corner, Per Both ELO and Bets

	(1)	(2)	(3)	(4)
Red Corner	0.007***	0.007***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	9570	9214	9214	9156
Fighter FEs		X	X	X
Location FEs			X	X
Controls				X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

Controls: fighter rating, opponent rating, total hits, significant strikes %

* p<0.10, ** p<0.05, *** p<0.01

Table 17: Win Due To Reasons Other Than Facial Cuts Rate Difference for Fighters Assigned to Red Corner, Per Both ELO and Bets

	(1)	(2)	(3)	(4)
Red Corner	0.343***	0.313***	0.314***	0.223***
	(0.012)	(0.014)	(0.014)	(0.013)
Observations	9570	9214	9214	9156
Fighter FEs		X	X	X
Location FEs			X	X
Controls				X

Standard errors in parentheses

Standard errors clustered at the fighter level.

OLS estimates.

Controls: fighter rating, opponent rating, total hits, significant strikes %

* p<0.10, ** p<0.05, *** p<0.01

Figures

Figure 1: Rank Vs. Elo Scatterplot

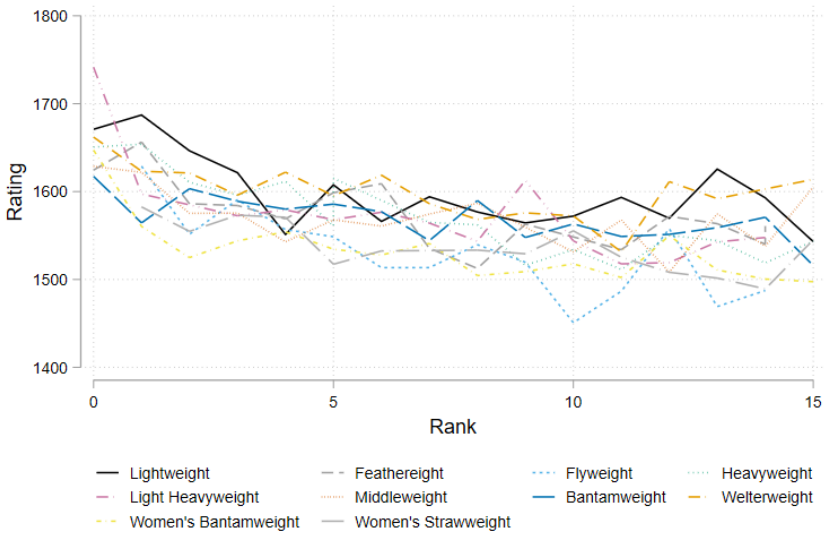
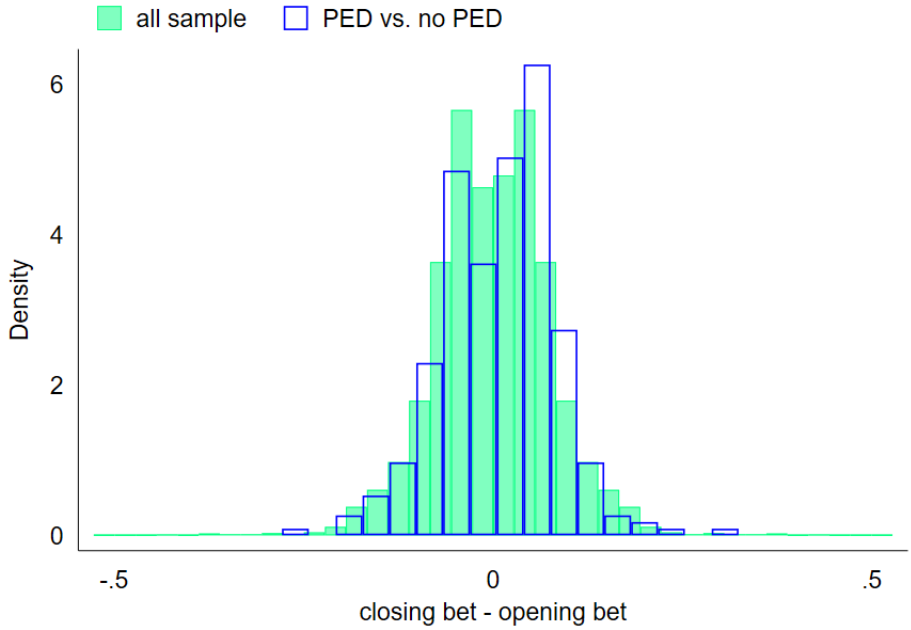


Figure 2: Opening and closing bet spreads.



Note: Opening bet is the first bet spread following the announcement of a lineup. Closing bet is the last available bet spread before the fight. A PED case is a fighter who was convicted for using performance enhancing drugs (PED).

Appendix

Table 18: Win Rate Difference for Fighters with Similar ELO Ratings Experienced Fighters

	(1) <45	(2) <35	(3) <25	(4) <15	(5) <5
Red Corner	0.307***	0.307***	0.291***	0.309***	0.363***
	(0.017)	(0.018)	(0.022)	(0.030)	(0.072)
Observations	5856	4956	3493	2072	469
Fighter FEs	X	X	X	X	X
Location FEs	X	X	X	X	X
Controls	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 19: Win Rate Difference for Fighters with Similar Bet Expectations Experienced Fighters

	(1) <.45	(2) <.35	(3) <.25	(4) <.15	(5) <.05
Red Corner	0.235***	0.226***	0.178***	0.020	2.741***
	(0.017)	(0.017)	(0.020)	(0.073)	(0.471)
Observations	5747	5451	3990	521	35
Fighter FEs	X	X	X	X	X
Location FEs	X	X	X	X	X
Controls	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01

Table 20: Win Rate Difference for Fighters with Similar Random Forest Votes Experienced Fighters

	(1) <.45	(2) <.35	(3) <.25	(4) <.15	(5) <.05
Red Corner	0.164***	0.136***	0.123***	0.054	0.089
	(0.019)	(0.023)	(0.030)	(0.050)	(0.212)
Observations	3644	2878	1965	948	134
Fighter FEs	X	X	X	X	X
Location FEs	X	X	X	X	X
Controls	X	X	X	X	X

Standard errors in parentheses

Standard errors clustered at the fighter level.

* p<0.10, ** p<0.05, *** p<0.01