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Do Professional Athletes Choke When They Don't Have Time to Stop and (Over) Think?*

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Abstract

Previous research suggests that professional athletes choke when performing unopposed high-pressure tasks, such as taking penalty kicks. This article extends the literature by studying whether football players choke when they have an opportunity to score in open-play situations. These situations are markedly different because in such instances players do not have time to stop and (over)think. We suggest that these situations closely resemble high-pressure professions and mirror many of the stressful scenarios we regularly experience. We find that players consistently underperform relative to expectations when their team is down by one goal. However, players perform to expectations when the game is tied. This finding is consistent with players being loss averse.

JEL Classifications: M54, Z13, J24

Keywords: Choking, Pressure, Football

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1 Introduction

According to economic theory, when the potential benefits are higher, individuals are motivated to exert more effort, leading to improved performance and greater output. However, behavioral economics has challenged this hypothesis and shown that *emotions* triggered in high-pressure situations might impair performance. The act of performing below expectations in high-pressure scenarios is commonly referred to as *choking* under pressure.

Naturally, social psychology has studied this phenomenon extensively. In recent years, economics has also become increasingly interested in this topic. Not only does choking go against standard economic assumptions, but it's also essential to understand whether the stakes at play impact our decision-making abilities.

Professional sports settings have been widely used to study this question. In particular, static and unopposed actions (such as free throws in basketball, putts in golf, diving competitions, and penalty kicks in football) have been used to analyze whether players underperform relative to their average performance in high-pressure situations. In general, these studies find that professional players tend to perform worse than expected in clutch moments when the game is on the line (Arrondel et al., 2019; Pope and Schweitzer, 2011; Ferraresi and Gucciardi, 2021; Cao et al., 2011; Genakos et al., 2015). More recently, neuroimaging has shown that choking occurs in this context because players *overthink*. In particular, fNIRS recordings show that task-irrelevant areas in the brain are activated when participants are placed in high-pressure situations (Slutter et al., 2021). This raises the question of whether individuals also choke in high-pressure situations where they do not have time to think about the outcome and consequences of their actions. Once again, sports provide a useful context for studying this question.

In this paper, we study whether professional football players falter under pressure when faced with scenarios when they don't have time to stop and overthink. In particular, we study athletes' performance in clutch situations when they have a chance to score in open-play opportunities (i.e. shots that are not the product of penalty kicks or free kicks). These open-play situations are markedly different from penalty kicks in that players presumably do not have time to consider the (positive and negative) consequences of their actions. In other words, open-play actions require players to make split-second decisions in terms of where to shoot, how to position their body, with what force to impact the ball, etc. In this context, players do not have the time to pause and overanalyze the consequences of their actions. We argue that these situations resemble high-pressure professions such as surgeons, air traffic controllers, and firefighters. Moreover, they better reflect many of the high-pressure scenarios we encounter regularly, such as exams, public presentations, and sensitive conversations. To the best of our knowledge, this is the first paper to study performance under pressure in such situations.

To conduct this study, we rely on a relatively new metric in football called *expected goals*, commonly referred to as xG. Using historical data from a library of previous shots with similar characteristics, these xG models estimate the probability that a shot is scored on a scale between 0 and 1. We use this metric to control for the quality of the goal-scoring opportunity created, which might be different in different late-game situations. The overall idea of the paper is to study whether players convert fewer than expected opportunities in high-pressure situations, once we control for the probability that the shot should result in a goal.

Overall, we find evidence that players do choke in late-game pressure situations. However, players only show evidence of choking when their team is behind by one goal. When the game is tied, players do not show any statistically significant difference in the rate at which they score a goal in goal-scoring opportunities. This would be consistent with the idea that players are loss-averse and that they feel more pressure in situations in which their actions can prevent a *loss*, rather than ones in which their actions can lead to a *win*.

2 Data and context

We have data on all shots taken in matches for the five main leagues in Europe (i.e.: England, Italy, Spain, Germany and France) from the 2015-16 to the 2022-2023 season. This data was provided to us directly through an agreement with Stats Perform[1], who collects this data. Table 1 shows the summary statistics for the data.

In order to assess whether players underperform in open-play high-pressure situations, we must control for the quality of the chances they take[2] In the last decade, the expected goal (xG) metric has become increasingly popular in football analytics. Taking into consideration certain characteristics about the shot (e.g.: location, angle of goal, assist type, the position and number of defenders in the vicinity of the shooter, etc.), xG represents the probability with which a given shot should result in a goal. Using an xG model trained on over 1 million shots, Stats Perform assigns an xG probability (from 0 to 1) to every shot taken in a match. We will use this xG measure to control for the quality of the goal-scoring opportunities created [3].

[1]Stats Perform is a sports data and analytics company.

[2]It is natural to imagine that in late game situations, when a team is down by one goal, the trailing team might take low probability shots out of desperation. Thus, it is crucial to control for the quality of the goal-scoring opportunity.

[3]In Appendix A we corroborate the accuracy of this measure across different scoring probabilities.

In order to study whether players choke, we analyze whether players perform worse than expected when they face high-pressure situations. Equipped with the xG measure that allows us to have an indication of the likelihood with which a particular shot should have been converted, we can define under-performance as converting fewer goals than expected. For this, we construct a conversion rate measure which is given by: $CR = \frac{\sum Goals}{\sum xG}$. Figure 1 is a first indication that players do choke in fact: When their team is down by one goal, the player's conversion rate drops significantly in the last minutes of play. This does not occur for other results (which include situations in which their team is winning or losing by more than one goal). Interestingly, we do not find evidence of choking when the game is tied and a player has an opportunity to give his team the lead. We will delve into this distinction in the next section.

3 Empirical strategy

The main objective of this paper is to understand whether players underperform in open-play goal-scoring opportunities in high-pressure situations. We define high-pressure situation as late-game situations that occur in stoppage time (i.e.: the time added to a match by the referees once the 90 minutes of regular time has been completed)[4]. Given that the potential gains and losses are different when your team is behind by one goal relative to when the game is tied[5], we include a dummy variable for different goal difference possibilities at the time the shot took place[6].

We formalize this comparison with the following model:

$$Goal_{ict} = \delta_c + \alpha_t + \sum_k \beta_k \{GoalDiff\}_i \times \{Post90\}_t + \gamma xG_{ict} + \nu Home_{ict} + \epsilon_c \qquad (1)$$

where $Goal_{ict}$ is a dummy variable indicating whether shot i taken by a player c at time t resulted in a goal. δ_c are player fixed effects to control for the unobserved heterogeneity in the quality of players and δ_t are year fixed effects to control for unobserved heterogeneity across years in terms of individual player characteristics (e.g., players gaining more experience, or teams and players expectations changing) and also to capture years in which Covid-19 disrupted the presence of fans in stadiums. $GoalDiff_i$ indicates the goal difference at the

[4]Several robustness checks will show that our main results are not affected by this arbitrary cutoff: players seem to exhibit a decrease in their performance late in the game, broadly defined.

[5]Since 1995, FIFA has formally adopted a point system in which teams obtain 3 points for a win, 1 point for a draw and 0 for a defeat.

[6]These are always from the perspective of the team taking the shot. We bin these goal differences as $\geq +2$, +1, 0, -1, and $\leq$ -2

time the shot was taken. $Post90_t$ is an indication of whether the shot was taken in stoppage time, after the 90th minute of play. The interaction of these two variables when the goal difference is -1 or the game is tied and the shot was taken in stoppage time represents scenarios that we consider to be of high pressure. We control for the probability with which shot i should have been converted with xG. We also include a dummy variable which indicates if player c was playing home or away. ϵ_c is the error term clustered at the player level. Given that our dependent variable is binary, we estimate Equation 1 using both a linear probability model and a Logit model.

One concern with the above specification is that it uses a scenario where the team is ahead by two or more goals as the reference point. Although we control for the quality of the goal-scoring opportunity, chances created in those scenarios might be qualitatively different than those created when the game is highly contested. To address this, we will also run an alternative specification that measures the probability of a shot resulting in a goal for each goal-difference scenario as the game progresses. For each goal-difference scenario, we estimate the following model:

$$Goal_{ict} = \delta_c + \alpha_t + \sum_t \gamma_t 15min_{ic} + \beta_1 xG_{ict} + \beta_2 Home_{ict} + \epsilon_c \quad (2)$$

4 Results

Findings are shown in Table 2. Column 1 shows the results of the Logit model. The results indicate that player's conversion rate decreases by about 16% when down by one goal in stoppage time. We find no effect for when the game is tied. Columns 2-4 shows results for the OLS model. Column 2 replicates the same specification as column 1 for comparison purposes. Columns 3 and 4 add player and year fixed effects. Overall, we find that when a team is down by one goal and in stoppage time, the probability that a shot results in a goal decreases by 1.7 percentage points. Given that the probability that any given shot results in a goal is 10%, this effect represents a 17% decrease in the probability of scoring. As for when the game is tied, the results show that players' performance is not significantly affected.

Taken together, these results seem to suggest that players are loss-averse. It may be natural for players to have a tie as a reference point. Consequently, they might feel more pressure when they have a goal-scoring opportunity while trailing, since their action can prevent a loss. On the other hand, when the game is tied, they could feel less pressure in similar situations, as failing to score might only prevent a win, rather than avert a loss.

The results in Table 2 stem from comparing players' performance in stoppage time when their team is down by one goal (or tied) to when their team is up by two goals or more.

Although we control for the quality of the goal scoring opportunity (xG), it could be the case that the scoring opportunities created in those two scenarios are qualitatively different in a way not entirely captured by the xG measure. As a robustness check, we now measure players' performance in successfully converting goal-scoring opportunities as the game progresses within each goal difference scenario (Equation 2).

Results are shown in Figure 2. Once again, we find evidence that when their team is down by one goal, players significantly perform worse than expected in stoppage time (e.g. after the 90th minute of regular time). This is not the case when the game is tied. In this scenario, performance is pretty consistent throughout the match.

5 Conclusion

Our analysis of choking in open-play scoring opportunities contributes to the existing literature showing that, even in situations where players have to make split second decisions that don't allow them to overthink, they still perform worse than expected.

These findings could suggest that once players recognize a situation to be of high pressure, they remain in a constant state of stress, impairing their decision-making ability until the pressure eases. The scenarios studied in this paper are similar to those experienced in high-pressure professions like paramedics and stock traders. Additionally, they closely resemble the kinds of high-pressure decisions we regularly face in everyday life, such as job interviews, presentations, and negotiations.

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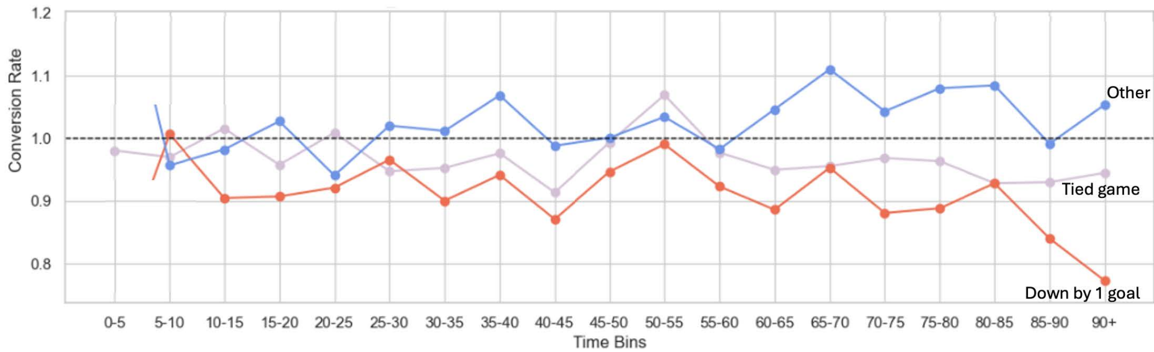
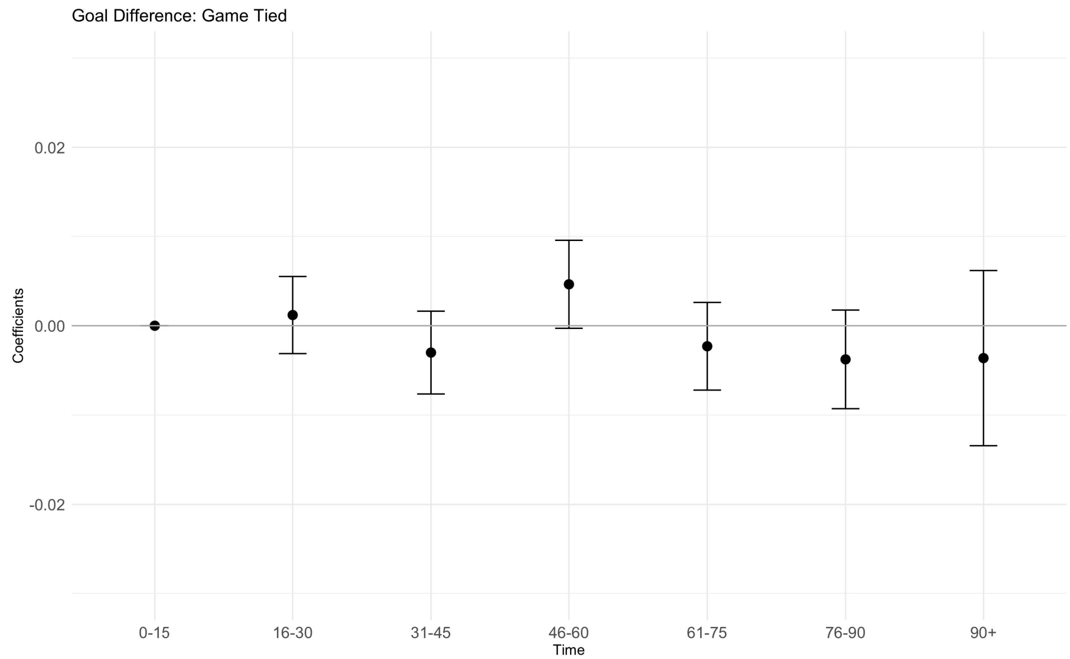
Figures and Tables

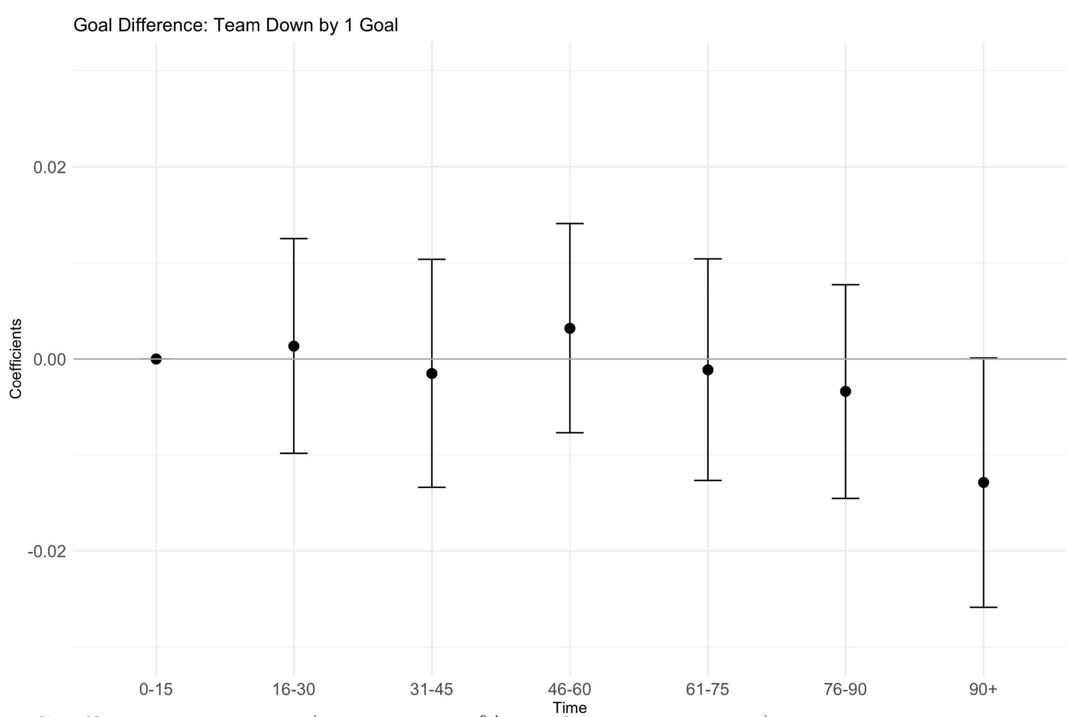
Figure 1: Conversion rate by time of match and goal difference



Notes: The figure plots the conversion rate ($CR = \frac{\sum Goals}{\sum xG}$) for shots taken in different times of the match. The orange line represents the conversion rate for shots taken when the team of the player taking the shot was down by one goal. The pink line represents scenarios in which the game was tied. The blue line includes all other scenarios. A conversion rate of 1 indicates that the number of goals scored is in line with the expected number of goals scored given by the xG measure. Conversely, a conversion rate below (above) 1 indicates that fewer (more) goals were scored than expected.

Figure 2: Trends in probability that shot results in a goal as match progresses. Top: when game is tied. Bottom: when team is down by 1 goal





Notes: Coefficient estimates (and their 95% confidence intervals) are reported. The dependent variable is a binary indicator of whether the shot resulted in a goal or not. The controls include xG and team and year fixed effects. Top figure: indicates coefficients for scenarios in which the game was tied. Bottom figure: indicates coefficients for scenarios in which the team that had the goal-scoring opportunity was behind by one goal.

Table 1: Summary statistics

	All	**Outcome-Altering Scenarios** **Goal Diff: 0**	 **Goal Diff: -1**
Shots	268,456	125,162	51,866
Avg. xG	0.113	0.108	0.108
	(0.154)	(0.149)	(0.150)
Goals (%)	9.040	9.495	10.155
Body part (%)			
Head	18.32	18.60	21.81
Left foot	31.89	31.86	30.11
Right Foot	49.31	49.03	47.50
After 90th min.			
Shots	14,954	4,127	3,967
Avg. xG	0.124	0.115	0.113
	(0.170)	(0.163)	(0.163)
Goals (%)	8.382	9.192	10.868
Body part (%)			
Head	19.77	22.36	27.30
Left foot	32.00	31.61	28.62
Right Foot	47.76	45.37	43.45

Notes: Table presents summary statistics. Column 1 has statistics on all shots in our dataset, columns 2 and 3 have information on the subset of shots taken when the game is tied or the team taking the shot is down by one goal. The bottom half of the table includes statistics for shots taken in stoppage time (after the 90 minutes of regular time) for each of those scenarios.

Table 2: The impact of pressure on goal conversion rates

	Logit	OLS		
	(1)	(2)	(3)	(4)
GDiff +1 × 90min	0.079	0.007	0.008	0.010
	(0.102)	(0.011)	(0.011)	(0.011)
GDiff 0 × 90min	-0.048	-0.005	-0.007	-0.007
	(0.097)	(0.009)	(0.009)	(0.009)
GDiff -1 × 90min	-0.178*	-0.015*	-0.017**	-0.017**
	(0.105)	(0.008)	(0.009)	(0.009)
GDiff -2 × 90min	-0.116	-0.004	-0.007	-0.007
	(0.114)	(0.009)	(0.009)	(0.009)
xG	✓	✓	✓	✓
Home	✓	✓	✓	✓
Player FE			✓	✓
Year FE				✓
Num.Obs.	268,456	268,456	267,148	266,144
R2		0.218	0.218	0.218
R2 Within			0.206	0.206

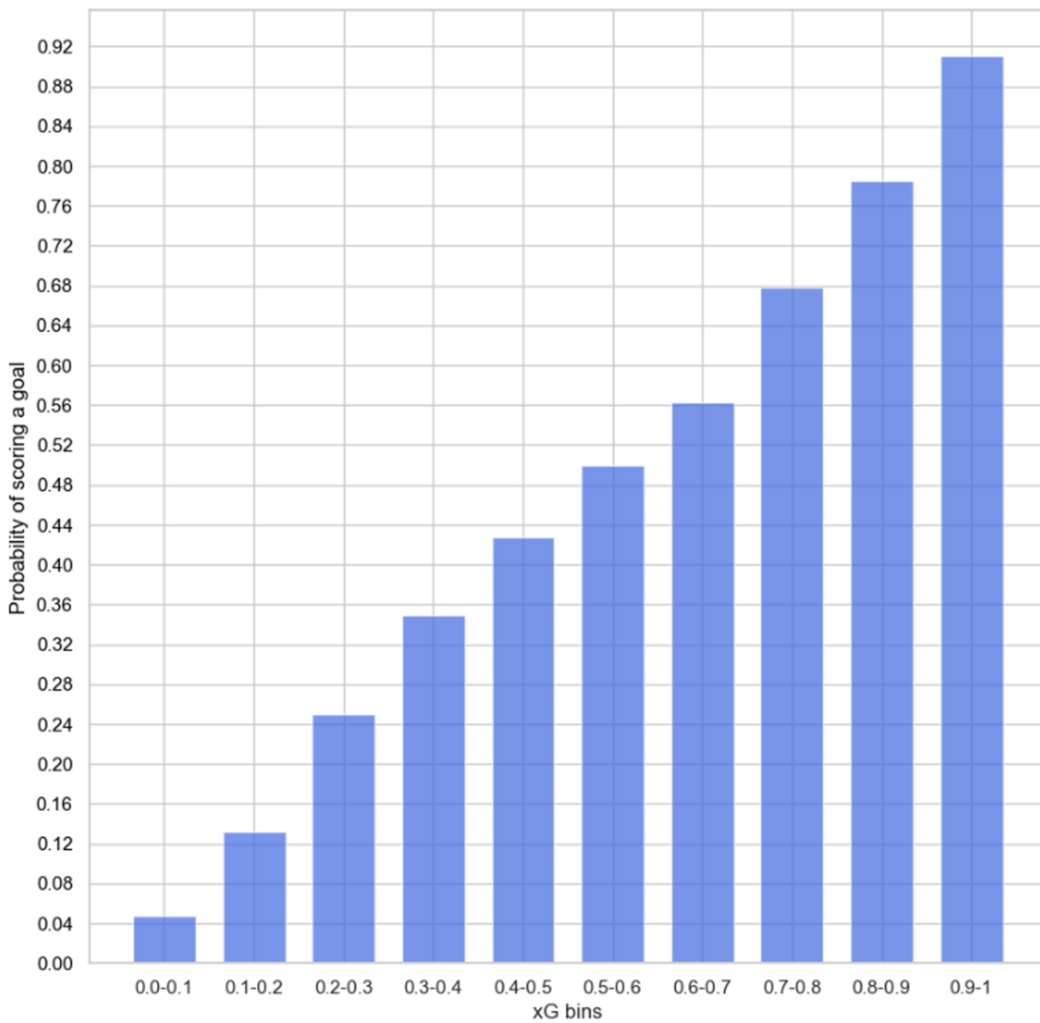
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$

Notes: Results from estimating linear probability and Logit models where the dependent variable is 1 if the shot resulted in a goal and 0 otherwise. Columns 1-2 show results for situations in which the team shooting on goal is losing by one goal and columns 3-4 for when the game is tied. In all cases, the control group is shots taken in all other goal difference scenarios. Robust standard errors are in parentheses.

A Precision of xG measure

To corroborate the accuracy of the xG measure across different probabilities, we bin all shots by their xG into 10 groups and examine if the total number of goals scored on those opportunities is similar to the expected number of goals for those opportunities. Figure 3 shows that the actual number of goals scored is in fact similar to the sum of the xG. The higher the attributed xG on the shot, the higher the probability that the shot was in fact converted.

Figure 3: Converted goals relative to xG



Notes: The figure plots the sum of converted goals binned by the xG attributed to the shot. We group each shot into 10 bins based on their xG.