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RESEARCH ARTICLE

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Field-based validation of penalty shooting recommendations: An experiment with elite youth football players

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Abstract

Research has suggested many ways in which professional football players can increase their penalty shooting success rate. We set up a field experiment testing these recommendations. We perform the experiment with one of the most successful youth academies in the world. All players are highly skilled, including prospective and current Brazilian youth national players. The players either decide themselves where to shoot or the coach tells them where to shoot. The coach does not reveal if the decision is based on a random allocation or his own choice. The algorithm randomly selects where players must shoot. The results from the experiment show that the best outcome is when players choose where they want to shoot. Coaches and random algorithm have a lower success rate, although following research-based recommendations. The findings are important as they show that researchers should test their recommendations in the field as they do not necessarily translate into real-life settings.

1 | INTRODUCTION

In the past decades, researchers have recognized the academic and general interest in penalty kicks. Analyzing penalty kicks is not only interesting from a scientific point of view but also provides straightforward implications. Theoretically, the task should be easy for kickers in professional football. Players have the physical skills to shoot the ball with high velocity in whichever spot of the goal they want. Extensive research shows, however, that the players mental state has a significant influence making penalties nontrivial (Jordet et al., 2009; Navia et al., 2019).

In a field experiment with college students, Horikawa and Yagi (2012) find that high anxiety leads to a higher likelihood of missing a penalty. Wilson et al. (2009) show that when a player fixates the goal and the keeper longer, shooting accuracy decreases. Using data from the highest German football league, Furley and Roth (2021) examine how nonverbal behavior influences penalty kicker behavior. They find that several behavioral traits—for example, right arm movement or body posture—influence the success rate.

Analyzing data from professional football, researchers describe ways that should increase penalty success rate without focusing on the player's mental state. For example, Noël et al. (2015) examine two different shooting strategies: first, if players continuously reassess where to shoot depending on the keeper or, second, if players already decided where to shoot independent of the keeper. They advise players to randomly use both strategies. Bar-Eli and Azar (2009) analyze penalties taken in top men's professional leagues worldwide. Their recommendation for players is to shoot to the upper corners of the goals. Although looking at another dataset, Almeida et al. (2016), Almeida and Volossovitch (2023), and Horn et al. (2021) have the same recommendation.

Chiappori et al. (2002) were the first to introduce the idea of randomizing penalties as an optimal strategy. This strategy has been picked up and recommended by other researchers. Palacios-Huerta (2003) finds that professionals already behave random—following the "optimal" strategy. Dohmen and Sonnabend (2018) confirm these results with a different data set. Analyzing four elite European football leagues, Jamil et al. (2020) suggest that players should study league differences

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and increase their unpredictability. However, implementing these chances might be difficult as players face real pressure when shooting a penalty, an area that another strand of research investigates.

Several studies examine the concept of "choking under pressure." A concept that examines whether athletes perform seemingly routine tasks worse under pressure (Beilock & Carr, 2001). Jordet (2009a) finds that players with a high current status perform worse when shooting penalties. Gómez et al. (2015) look at the last 5 min in Spanish professional basketball—a time of the game when players are under pressure. They find that winning teams outperform losing teams in several factors (e.g., field goals and free throws). Cohen-Zada et al. (2017) analyze how tennis players fare in low- and high-stake situations. Their results show that men are more likely than women to choke under pressure. Harb-Wu and Krumer (2019) find that biathletes underperform in their home countries under pressure.

In this paper, we examine how football players shoot penalties when they decide where to shoot, or their coach, or a random algorithm. We perform an artifactual field experiment with 55 youth players (U15 and U16) from a professional first tier Brazilian football club. We see the setup experiment closest to an artifactual field experiment. "An artefactual field experiment is the same as a conventional lab experiment but with a nonstandard subject pool" (Harrison & List, 2004). The club developed several current and former Brazilian national players. Thus, all players are highly skilled and have the necessary physical skills to shoot a penalty accurately.

We have three groups: players choosing where they want to shoot, coaches telling the players their decision where to shoot, and coaches telling the players the decision from a random algorithm where to shoot. The coaches do not tell the players if their decision is their own opinion or the decision of the random algorithm. Given that coaches collaborate closely with players year-round, they might possess insights that can optimize penalty outcomes. Additionally, in professional football, coaches often advice players where to shoot before a penalty. Finally, we included a random algorithm as coaches, unconsciously, might hesitate to advise their players to shoot in a specific direction because of previous unrelated experience. Research suggests that players make several nonoptimal decisions. Thus, with the random algorithm, we can see if the research based recommendations of randomization and, thus, more shots to the top corners outperform the players choice.

The results from the experiment show, however, that advising players where to shoot statistically significantly decreases the success rate. Players have the highest chance to score a penalty when they choose themselves and a lower chance when the coach or a random algorithm through the coach advises them where to shoot.

A critique of many academic studies is that experimental results are as expected. Thus, we wanted to know how experts in the field expected players to fare. So, we asked coaches and academics in sports science in an online survey what the best and worst method was; 13% of the respondents ($n = 38$) thought that it does not make a difference who decides; 24% thought that the players make the best decision, and 63% thought that either the random algorithm (21%) or the coaches (42%) make the best decision; 24% thought that the random algorithm makes the worst decision, and 58% thought that either coaches (32%) or players (26%) make the worst decision. These expectations show that the majority have a misconception regarding how to optimize penalty shooting.

This research is important as it empirically validates the effectiveness of penalty shooting strategies in a genuine competitive context, specifically within a top-tier youth academy. The setting underscores the distinction between theoretical suggestions and practical outcomes, shedding light on the potential limitations of research-based recommendations when applied in real-world scenarios. Highlighting the superiority of players' self-selected decisions over those influenced by coaches or random algorithms, this research emphasizes the need for context-specific evaluation to enhance the applicability of sports performance advice.

2 | METHOD: EXPERIMENTAL SETUP AND DATA

We worked together with the director of the youth academy of a Brazilian professional football club. The club won multiple trophies, and the first men's team plays in the highest Brazilian league. The director is responsible for all youth teams. We discussed the setup and the implementation with the director and made sure that the timing of the experiments fitted to the club's schedule. The club chooses to stay anonymous. We choose to work with this specific club as it is one of the most successful youth academies in the world, training youth players that are highly skilled, and as the academy was keen in implementing our recommendations.

We performed the experiment with the male teams for players under 15 (U15) and under 16 (U16). The U15 had 29 players and three goalkeepers, and the U16 had 26 players and four goalkeepers. The coaches for each team told their players that they would have one training session practicing penalties. It was not unusual for the players that our research group was present during the penalty training session. Many supporters, a group of coaches, and visitors (e.g., prospective players, football agents, and relatives) are present during each training. Thus, it is unlikely that the results suffer from a Hawthorne effect, that is, respondents modifying their behavior because they know that they are participating in an experiment (Sedgwick & Greenwood, 2015).

2.1 | Group assignment: control group

We created a control and two treatment groups. In the control group, the players decided where to shoot. In the two treatment groups, the coaches or a random algorithm decided where to shoot. A complete group consisted of three rounds. In each round, every team player shot one penalty. After everyone was done, the first player would start again. The position when a player shot was randomly determined before the start. All players participated in both groups and, hence, shot six times each. This eliminates a potential bias where high (low) skilled players could be assigned for a specific group, potentially deceiving the results.

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2.2 | Group assignment: treatment group

The coaches did not interfere during or after the penalties when the players decided where to shoot. The structure in the treatment groups was the same. However, before every shot, the coaches verbally told the players where to shoot. The coaches did not give the players additional negative or positive information as previous research shows that this can have a significant effect on the outcome (Bakker et al., 2006). One researcher from our group verbally told the coaches before each shoot, if the coaches could decide or an algorithm that randomly selected where to shoot. The random algorithm, using the randomization process with the computer program Stata, randomly chooses the direction of the shot. Each choice is independent of the previous choice. We gave the coaches enough time to contemplate where players should shoot. The coach told the players only where to shoot but not if it was his or the algorithms choice. We randomly selected if the coaches choose or the algorithm chooses. The researcher talking to the coach had a list, which either specified where players had to shoot or if coaches decided to shoot. We used block randomization, where each block consisted of one shot for each player. Within this block, a player would have a 50% chance to receive advice from the coach or from the random algorithm.

The coaches told the players one of five different possibilities: center, left low, right low, left high, and right high. Together with the coaching team, we decided against using two categories for center. Many players and coaches use a single concept for center and do not distinguish between high or low in this area. The goalkeepers were informed that this was part of their training and that they were tested for their abilities during penalties.

For the U15, we started with the control group—players decided where to shoot. For the U16, the first group was the treatment—coaches and the algorithm decided where to shoot. The second group was the respective other group.

TABLE 1 Experiment results overview, organized into three columns based on who decided the shooting direction: coach, player, or random algorithm.

		Coach chooses		Player chooses		Random algorithm chooses	
		Goal %	*N* (shots)	Goal %	*N* (shots)	Goal %	*N* (shots)
Direction of shot	Left low	.90	20	.86	52	.72	18
	Left high	.69	16	.94	18	.58	19
	Center	.83	12	.72	22	.69	16
	Right low	.95	22	.90	49	.93	15
	Right high	.64	14	.96	24	.62	13
Shot on target		.85	71	.95	157	.80	65
	And goal	.97	69	.92	145	.88	57
	And saved	.03	2	.08	12	.12	8
Shot off target		.15	13	.05	8	.20	16
Player in experiment had first shot[a]		.87	23	.93	54	.66	32
	Second shot	.78	32	.88	56	.83	23
	Third shot	.83	29	.84	55	.65	26
Player in experiment is[b]	Right footed[c]	.85	60	.89	117	.70	57
	Left footed	.71	21	.90	39	.72	18
Goalkeeper in experiment	Number 1	.94	16	.93	29	.57	14
	Number 2	.88	17	.90	29	.67	12
	Number 3	.64	14	.86	29	.93	14
	Number 4	.92	12	.96	23	.75	8
	Number 5	.67	9	.78	23	.64	11
	Number 6	.71	7	.87	23	.50	12
	Number 7	.89	9	.78	9	.90	10
Total (mean)		.82	84	.88	165	.70	81
Standard deviation		(.39)		(.32)		(.46)	

[a]First shot in each setting—thus, if coach, player, or random algorithm chooses. Each player took a total of six shots.
[b]The footedness for the players was provided to the researchers in a list from the coaches. Each player, during the experiment, used the foot as specified in the list.
[c]The footedness for three players was unclear. They could be left footed, right footed, or ambidextrous. These observations are marked as empty and not included in the full model.
$^{*}p < .1$. $^{**}p < .05$. $^{***}p < .01$.

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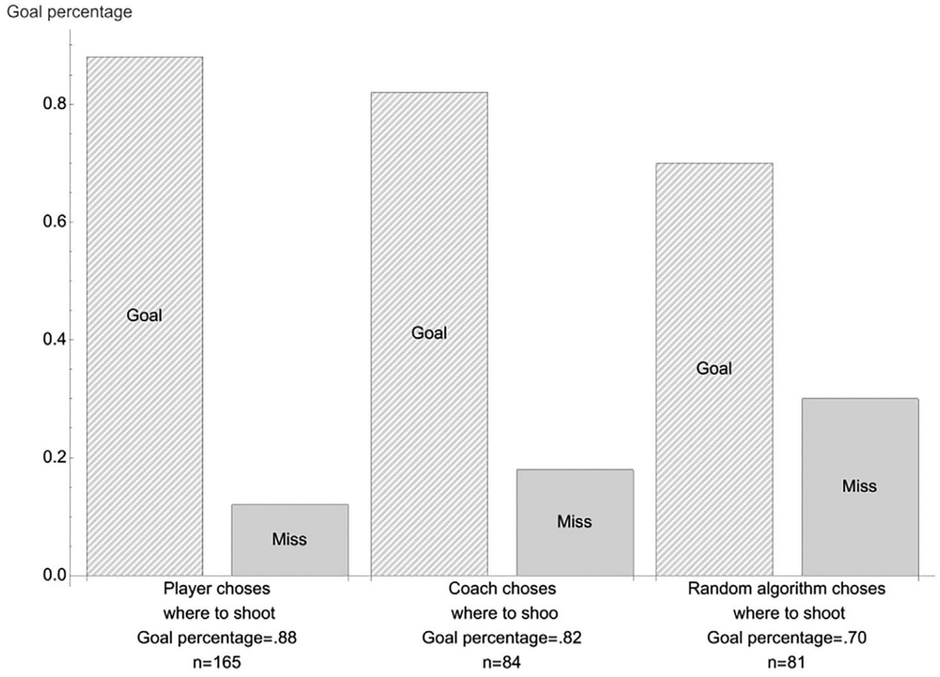

FIGURE 1 Goal percentages when coach, player, or random algorithm decides where to shoot.

TABLE 2 Probit regression results.

	Model 1	Model 2	Model 3	Model 4	Model 5
Coach chooses where to shoot	−0.45	−0.39	−0.37	−0.39	−0.46
	(0.37)	(0.38)	(0.38)	(0.38)	(0.39)
Random algorithm chooses where to shoot	−1.12***	−0.97***	−0.98***	−1.01***	−1.01***
	(0.34)	(0.35)	(0.35)	(0.36)	(0.37)
Right footedness			0.21	−0.90	−0.88
			(0.35)	(0.65)	(0.66)
Natural side			−0.15	−0.21	−0.27
			(0.38)	(0.39)	(0.40)
Direction					
Left low		0.53	0.66	0.72	0.86
		(0.44)	(0.53)	(0.55)	(0.57)
Left high		0.04	0.17	0.29	0.34
		(0.46)	(0.54)	(0.56)	(0.58)
Right low		1.26**	1.33**	1.37**	1.41**
		(0.52)	(0.53)	(0.54)	(0.55)
Right high		0.20	0.27	0.31	0.46
		(0.48)	(0.50)	(0.50)	(0.52)
Player position dummy				Yes	Yes
Goalkeeper dummy					Yes
(Intercept)	1.98***	1.49***	1.31***	2.36***	2.47***
	(0.24)	(0.38)	(0.49)	(0.79)	(0.86)
Num.Obs.	330	330	330	330	330
Log.Lik.	−149.578	−145.127	−144.889	−141.348	−137.693
F	5.402	2.952	2.266	1.815	1.554

*$p < .1$.**$p < .05$.***$p < .01$.

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We categorized the direction of the shot, if it was a goal, if it hit the target, if the goalkeeper saved the shot, who decided where to shoot (coach, player, or randomization), which goalkeeper was in the goal, the number of each shot, and whether a player shoot for the first, second, or third time. Every shot was categorized by one researcher and one research assistant. This ensured that we categorized the shoots correctly. Table 1 gives an overview about the data.

The data supporting the findings of this study are publicly available (upon publication) in HarvardDataVerse, 10.7910/DVN/YRWKKM. The data do not contain any individual identifiable information.

3 | RESULTS

After running the experiment, we examined who had the highest scoring percentage. Figure 1 shows the results for each group. The two treatment groups had a lower scoring percentage. The random algorithm had the worst performance with a goal percentage of around 70%. Coaches had a higher goal percentage of around 82%. The control group—players choosing themselves—had the highest goal percentage: 88%.

However, ample evidence exists that states that several variables have an important influence on the outcome of a penalty: players being right or left footed (Baumann et al., 2011; Dohmen, 2008), strength or tiredness differences of individual goalkeepers (Jordet, 2009b; Wood & Wilson, 2010), or tiredness of the players (Smith et al., 2016). Nonetheless, the results from randomized control trials should, theoretically, not be influenced by these factors (Gerber & Green, 2008). Still, it makes sense to account for these factors as they provide interesting insights regarding their effect and the validity of the experiment.

We run a probit regression analysis to evaluate the effect of three shooting strategies. A probit regression is appropriate when the dependent variable is binary because it models the probability of binary outcomes and provides estimates that are bounded between 0 and 1. The respective regression looks as follows:

$$P(Goal_{ij}=1) = \Phi\Big(\beta_0 + \beta_1 \cdot \text{Player chooses}_{ij} + \beta_2 \cdot \text{Random algorithm chooses}_{ij} + X_i\gamma + \varepsilon_i\Big)$$

Φ represents the cumulative distribution function of the standard normal distribution. The dependent variable, *Goal*, is binary: It is 1 if player i scores on attempt j, and 0 if the goalkeeper stops the ball or the player misses. This binary variable indicates 1 for apositive outcome (goal) and 0 for a negative outcome (no goal). Player chooses and random algorithm chooses are binary variables indicating the shooting strategy. X_i is a vector of control variables, which includes the direction of the shoot, the position of the player in the experiment, the goalkeeper effects, and the footedness of the player. Additionally, previous research finds that players tend to prefer their "natural side." For a right-footed player, the natural side is shooting to

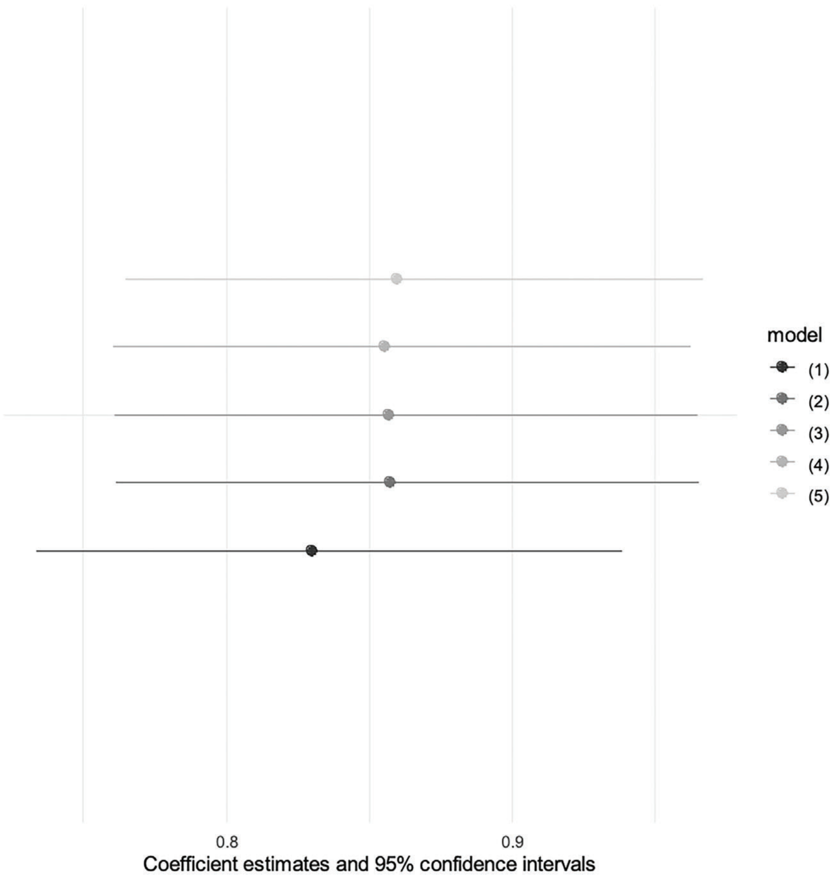

FIGURE 2 Marginal effects for the variable random algorithm chooses where to shoot.

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the left and vice versa for a left-footed player (Palacios-Huerta, 2003). Table 2 shows the results for all the models, Figure 2 represents marginal effect for the variable if the random algorithm chooses where to shoot.

Table 2 confirms the results we presented in Figure 1. We choose player chooses as a reference group as we want to compare how the other two control variables perform compared to this variable. When the coach or the random algorithm chooses where to shoot, the chances are lower to score a goal. However, the results are only statistically significantly worse for the random algorithm. Including control variables decreases the difference between the three options but does not influence the results in a meaningful way. Figure 2 shows that the marginal effect is also stable across all the models.

The chances to shoot a goal increase when players shoot right low. However, this is only statistically significant for all models if the players shoot to the right. Shooting to the center—the baseline in the models—results in the lowest chance to score a goal. Interestingly, footedness has not any significant influence on the chances to score. Shooting to the natural side or the position of the experiment are not statistically different from zero.

To further test the robustness of our results, we estimate a mixed effect model. Mixed effect models are useful when using have a dataset with multiple levels of variation, such as repeated measures or hierarchical data. They allow for the inclusion of both fixed and random effects, which can help to account for the variability in the data that is not explained by the standard probit regression alone. In contrast, regular probit models assume that all observations are independent and identically distributed, which may not be appropriate for our case, since there are groups of three shots taken from the same player.

We estimate a mixed regression model, where coefficients for our main variables of interest, player chooses and random algorithm chooses, are allowed to vary by player. Table 3 reports the results of the estimation. Table 4 reports the results of ANOVA tests

TABLE 3 Probit regression results.

	Model 1	Model 2	Model 3	Model 4	Model 5
Coach chooses where to shoot	−0.05	−0.04	−0.04	−0.04	−0.05
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Random algorithm chooses where to shoot	−0.20***	−0.17***	−0.17***	−0.17***	−0.17***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Right footedness			0.03	−0.07	−0.07
			(0.05)	(0.07)	(0.07)
Natural side			−0.02	−0.01	−0.03
			(0.05)	(0.05)	(0.05)
Direction					
Left low		0.09	0.11	0.09	0.11
		(0.06)	(0.08)	(0.08)	(0.08)
Left high		0.02	0.03	0.03	0.04
		(0.07)	(0.08)	(0.08)	(0.08)
Right low		0.15**	0.16**	0.16**	0.16**
		(0.06)	(0.07)	(0.07)	(0.07)
Right high		0.04	0.05	0.04	0.06
		(0.07)	(0.07)	(0.07)	(0.07)
intercept	0.88***	0.80***	0.77***	0.88***	0.91***
	(0.03)	(0.06)	(0.07)	(0.10)	(0.11)
Player position dummy				Yes	Yes
Goalkeeper dummy					Yes
Mixed effects:					
SD (intercept Player)	0.00	0.00	0.00	0.00	0.00
SD (coachChoose Player)	0.09	0.08	0.08	0.08	0.08
SD (randomizationChoose Player)	0.29	0.28	0.28	0.28	0.28
Cor (coachChoose randomizationChoose Player)	1.00	1.00	1.00	1.00	1.00
SD (observations)	0.35	0.35	0.35	0.35	0.35
Num.Obs.	330	330	330	330	330
R2 Marg.	0.049	0.070	0.072	0.087	0.110

*$p < .1$. **$p < .05$. ***$p < .01$.

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TABLE 4 Random coefficients ANOVA test results.

	npar	logLik	LRT	*df*	Pr (> χ^2)
Model 1					
Coach random slope effect	7	−147.6	2.6	3	0.5
Randomization random slope effect	7	−152.8	13.1	3	0.004***
Model 2					
Coach in random slope effect	11	−151.5	2.3	3	0.5
Randomization random slope effect	11	−156.2	11.6	3	0.01**
Model 3					
Coach in random slope effect	13	−155.4	2.4	3	0.5
Randomization random slope effect	13	−160.0	11.6	3	0.01**
Model 4					
Coach in random slope effect	18	−161.4	2.2	3	0.5
Randomization random slope effect	18	−165.4	10.3	3	0.02*
Model 5					
Coach in random slope effect	24	−168.3	2.4	3	0.5
Randomization random slope effect	24	−172.0	9.7	3	0.02*

*$p < .1$.**$p < .05$.***$p < .01$.

of random-effect terms in the model. Each random-effect term is reduced or removed and likelihood ratio tests of model reductions are presented in the table.

The result from Table 3 is that our main finding is the same: Randomization decreases the chances to score. The effect size, however, is substantially lower compared to marginal effect from Figure 2. So, despite the main results still holding, it is important to account for the nested structure of data, since some variation can be explained by the structure of data, not the difference in scoring strategies. As Table 4 shows, the random effect of player matters when random algorithm chooses the direction but not in case if a player chooses.

4 | DISCUSSION

Coaches and random algorithm choose more frequently a shot to the top corners than the players themselves. Previous research has suggested that players should more often choose top corners to increase their success rate (Almeida & Volossovitch, 2023; Almeida et al., 2016; Bar-Eli & Azar, 2009). Our findings show evidence that players are less likely to score when not choosing themselves to shoot in the top corners. One explanation could be that players are forced to shoot somewhere where they do not feel comfortable. They consciously did not choose to shot high before as they feel more comfortable shooting low. Research shows that athletes, when feeling under pressure, underperform (Cohen-Zada et al., 2017; Harb-Wu & Krumer, 2019). Thus, their success rate decreases as they are forced away from their optimal choice.

Both coaches and random algorithm followed research recommendations more closely than the players. The random algorithm, theoretically, should have outperformed both coaches and players. Players were forced to shoot at least 40% of their penalties into the top corners. Coaches increased the chances to shoot into the top corners but not as much as the algorithm. The results show, however, that players are less successful when following advice—irrespective if it is academic advice or advice from the coach. The underperformance of the algorithm can be attributed to its lack of real-time adaptation to the opposing goalkeeper's behavior. This is an strategic advantage that players possess. Moreover, players' intuitive decision-making, informed by their experience, might lead to higher success rates as they choose penalty kick locations aligned with their strengths. In contrast, the algorithm's suggestions could compel players to attempt kicks beyond their capabilities, potentially resulting in lower success rates. This result is important for future research. It shows that it is necessary to test if research results from secondary sports data are easily translatable into real life. The data from this experimental setup show that, in the short term, recommendations do more harm than good.

The results show that the success rate for players when they choose themselves is extremely high (88%). Professional football players in competitive settings normally do not have such a high success rate. It is important to look at this from at least three different perspectives. The first perspective focuses on players. Although under pressure during practice, a penalty is psychologically far more difficult during a match or a shoot-out. Thus, it might be psychological pressure that leads to a lower penalty success rate compared to training. The second perspective focuses on advice given to players. Coaches and fellow players regularly advise penalty kickers. The results from this research, however, show that it is questionable if professionals' benefit from being advised. Thus, the lower success rate in matches compared to training can be due to higher psychological pressure or unnecessary advice from coaches or both. Third, players have more information about the goalkeepers with whom they practice than about the goalkeepers from their opponents. In this sense, knowing a goalkeeper could increase the likelihood of scoring a penalty kick

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during a training session or an experiment and, thus, inflate the success rate.

Future research could perform the experiment with adult players. The psychological framework for adult and youth player tends to be different, since adult players have more playing experience and might behave differently shooting a penalty. Moreover, the biological development stage of youth players varies between and within categories, which could impact the results. We encourage further research with adult players. It would be interesting to see whether the results change. Additionally, our analysis does not incorporate mental or physical fatigue, which players can face in, for example, a penalty shoot-out. Future research could imitate these situations to get more realistic results. Moreover, our sample is homogeneous in terms of gender, age, and nationality. A more heterogeneous sample might reveal interesting avenues. Finally, we encourage future research to explore the integration of advanced computer algorithms, specifically those incorporating historical data on both goalkeepers and penalty takers. This avenue offers an opportunity of refining suggestions for optimal decision-making by leveraging computational insights derived from comprehensive training.

In conclusion, our study sheds light on the dynamics of penalty kick decision-making among youth football players. While coaches and algorithms often emphasize top corners, players' intuitive choices aligning with their strengths yielded significantly higher success rates. This challenges conventional wisdom and suggests that imposing recommendations, whether academic or coach-derived, may hinder player performance under pressure.

AUTHOR CONTRIBUTIONS

All authors contributed equally to this work.

CONFLICT OF INTEREST STATEMENT

The authors report there are no competing interest to declare.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are publicly available (upon publication) in HarvardDataVerse, 10.7910/DVN/YRWKKM. The data do not contain any individual identifiable information.

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REFERENCES

Almeida, C. H., & Volossovitch, A. (2023). Multifactorial analysis of football penalty kicks in the Portuguese first league: A replication study. *International Journal of Sports Science & Coaching*, *18*(1), 160–175. https://doi.org/10.1177/17479541221075722

Almeida, C. H., Volossovitch, A., & Duarte, R. (2016). Penalty kick outcomes in UEFA club competitions (2010-2015): The roles of situational, individual and performance factors. *International Journal of Performance Analysis in Sport*, *16*(2), 508–522. https://doi.org/10.1080/24748668.2016.11868905

Bakker, F. C., Oudejans, R. R., Binsch, O., & Van Der Kamp, J. (2006). Penalty shooting and gaze behavior: Unwanted effects of the wish not to miss. *International Journal of Sport Psychology.*, *37*(2-3), 265–280.

Bar-Eli, M., & Azar, O. H. (2009). Penalty kicks in soccer: An empirical analysis of shooting strategies and goalkeepers' preferences. *Soccer & Society*, *10*(2), 183–191. https://doi.org/10.1080/14660970802601654

Baumann, F., Friehe, T., & Wedow, M. (2011). General ability and specialization: Evidence from penalty kicks in soccer. *Journal of Sports Economics*, *12*(1), 81–105. https://doi.org/10.1177/1527002510371194

Beilock, S. L., & Carr, T. H. (2001). On the fragility of skilled performance: What governs choking under pressure? *Journal of Experimental Psychology: General*, *130*(4), 701–725. https://doi.org/10.1037/0096-3445.130.4.701

Chiappori, P.-A., Levitt, S., & Groseclose, T. (2002). Testing mixed-strategy equilibria when players are heterogeneous: The case of penalty kicks in soccer. *American Economic Review*, *92*(4), 1138–1151. https://doi.org/10.1257/00028280260344678

Cohen-Zada, D., Krumer, A., Rosenboim, M., & Shapir, O. M. (2017). Choking under pressure and gender: Evidence from professional tennis. *Journal of Economic Psychology*, *61*, 176–190. https://doi.org/10.1016/j.joep.2017.04.005

Dohmen, T., & Sonnabend, H. (2018). Further field evidence for minimax play. *Journal of Sports Economics*, *19*(3), 371–388. https://doi.org/10.1177/1527002516656729

Dohmen, T. J. (2008). Do professionals choke under pressure? *Journal of Economic Behavior & Organization*, *65*(3–4), 636–653. https://doi.org/10.1016/j.jebo.2005.12.004

Furley, P., & Roth, A. (2021). Coding body language in sports: The nonverbal behavior coding system for soccer penalties. *Journal of Sport and Exercise Psychology*, *43*(2), 140–154. https://doi.org/10.1123/JSEP.2020-0066

Gerber, A. S., & Green, D. P. (2008). Field experiments and natural experiments. In J. M. Box-Steffensmeier, H. E. Brady, & D. Collier (Eds.), *The Oxford handbook of political methodology*. Oxford Academic. https://doi.org/10.1093/oxfordhb/9780199286546.003.0015

Gómez, M. Á., Lorenzo, A., Jiménez, S., Navarro, R. M., & Sampaio, J. (2015). Examining choking in basketball: Effects of game outcome and situational variables during last 5 minutes and overtimes. *Perceptual and Motor Skills*, *120*(1), 111–124. https://doi.org/10.2466/25.29.PMS.120v11x0

Harb-Wu, K., & Krumer, A. (2019). Choking under pressure in front of a supportive audience: Evidence from professional biathlon. *Journal of Economic Behavior & Organization*, *166*, 246–262. https://doi.org/10.1016/j.jebo.2019.09.001

Harrison, G. W., & List, J. A. (2004). Field experiments. *Journal of Economic Literature*, *42*(4), 1009–1055. https://doi.org/10.1257/0022051043004577

Horikawa, M., & Yagi, A. (2012). The relationships among trait anxiety, state anxiety and the goal performance of penalty shoot-out by university soccer players. *PLoS ONE*, *7*(4), e35727. https://doi.org/10.1371/journal.pone.0035727

Horn, M., de Waal, S., & Kraak, W. (2021). In-match penalty kick analysis of the 2009/10 to 2018/19 English Premier League competition. *International Journal of Performance Analysis in Sport*, *21*(1), 139–155. https://doi.org/10.1080/24748668.2020.1855052

Jamil, M., Littman, P., & Beato, M. (2020). Investigating inter-league and inter-nation variations of key determinants for penalty success across European football. *International Journal of Performance Analysis in Sport*, *20*(5), 892–907. https://doi.org/10.1080/24748668.2020.1794720

Jordet, G. (2009a). When superstars flop: Public status and choking under pressure in international soccer penalty shootouts. *Journal of Applied Sport Psychology*, *21*(2), 125–130. https://doi.org/10.1080/10413200902777263

10991468, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/mde.4283 by Leeds Beckett University, Wiley Online Library on [08/07/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Jordet, G. (2009b). Why do English players fail in soccer penalty shootouts? A study of team status, self-regulation, and choking under pressure. *Journal of Sports Sciences*, *27*(2), 97–106. https://doi.org/10.1080/02640410802509144

Jordet, G., Hartman, E., & Sigmundstad, E. (2009). Temporal links to performing under pressure in international soccer penalty shootouts. *Psychology of Sport and Exercise*, *10*(6), 621–627. https://doi.org/10.1016/j.psychsport.2009.03.004

Navia, J. A., Van der Kamp, J., Avilés, C., & Aceituno, J. (2019). Self-control in aiming supports coping with psychological pressure in soccer penalty kicks. *Frontiers in Psychology*, *10*, 1438. https://doi.org/10.3389/fpsyg.2019.01438

Noël, B., Furley, P., Van der Kamp, J., Dicks, M., & Memmert, D. (2015). The development of a method for identifying penalty kick strategies in association football. *Journal of Sports Sciences*, *33*(1), 1–10. https://doi.org/10.1080/02640414.2014.926383

Palacios-Huerta, I. (2003). Professionals play minimax. *The Review of Economic Studies*, *70*(2), 395–415. https://doi.org/10.1111/1467-937X.00249

Sedgwick, P., & Greenwood, N. (2015). Understanding the Hawthorne effect. *BMJ*, *351*, h4672. https://doi.org/10.1136/bmj.h4672

Smith, M. R., Coutts, A. J., Merlini, M., Deprez, D., Lenoir, M., & Marcora, S. M. (2016). Mental fatigue impairs soccer-specific physical and technical performance. *Medicine & Science in Sports & Exercise*, *48*(2), 267–276. https://doi.org/10.1249/MSS.0000000000000762

Wilson, M. R., Wood, G., & Vine, S. J. (2009). Anxiety, attentional control, and performance impairment in penalty kicks. *Journal of Sport and Exercise Psychology*, *31*(6), 761–775. https://doi.org/10.1123/jsep.31.6.761

Wood, G., & Wilson, M. R. (2010). A moving goalkeeper distracts penalty takers and impairs shooting accuracy. *Journal of Sports Sciences*, *28*(9), 937–946. https://doi.org/10.1080/02640414.2010.495995

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