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Uncovering biases in disciplinary actions: Evidence from German soccer

Marco Henriques Pereira
University of Zurich

Abstract

While the disciplinary actions of referees towards home and away teams in soccer have been extensively analyzed, only a few studies focus on how individual player characteristics may influence these decisions. This study examines the impact of player characteristics on the likelihood of receiving yellow and red cards in professional soccer. Using a comprehensive dataset from the German Football Bundesliga from 2011 to 2018, I employ fixed-effects regressions to explore these relationships. I find that a player's distance covered, height, nationality, playing time, and position impact the likelihood of receiving disciplinary action. The results have implications for future research and yield practical implications for all stakeholders in the sports ecosystem.

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Contact: Marco Henriques Pereira - marco.pereira@crsa.uzh.ch.
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1. Introduction

In soccer, yellow and red cards are not just disciplinary symbols but can alter the game's narrative (Dawson et al., 2007). The issuance of these cards goes beyond player suspension, influencing team dynamics, the psychological aspects on the pitch, and even game and championship outcomes (Sutter and Kocher, 2004).

Previous research has mainly focused on team-level differences in disciplinary actions, frequently examining the advantage of playing at home versus away (Boyko et al., 2007; Courneya and Carron, 1992; Pollard, 2008). Empirical evidence consistently supports a bias favorable to home teams, attributable to the influence of crowd-induced social pressure on referee decisions (Garicano et al., 2005; Nevill et al., 2002; Pettersson-Lidbom and Priks, 2010). Some studies have extended the analysis to other team-level characteristics, such as running performance, nationality, and reputation, which potentially influence referee decisions (Dawson & Dobson, 2010; Wicker et al., 2022). Despite this, research exploring the impact of individual player characteristics on referee behavior remains scarce. One notable study revealed that taller players are more likely to be penalized with fouls (Van Quaquebeke and Giessner, 2010), highlighting the relevance of player characteristics in refereeing decisions.

Studying disciplinary actions at the individual level is crucial because it allows for a more nuanced understanding of how personal characteristics affect the decisions made on the field. While team-level analyses provide insights into collective biases and trends, individual-level analyses can pinpoint specific factors that might predispose certain players to receive more or fewer cards. Such insights are invaluable for refining training approaches, developing fairer play strategies, and informing more balanced officiating guidelines.

To fill this gap in the literature, this research explores how individual player characteristics correlate with the likelihood of receiving yellow or red cards. The objective is to refine our understanding of how player-specific factors influence disciplinary actions within professional soccer. The findings of this study have significant implications for multiple stakeholders in the soccer ecosystem by potentially enhancing strategies for referee training and player management.

2. Methods

This paper uses data from the 2011/2012 through 2017/2018 seasons from the Bundesliga, Germany's top professional soccer league. The data sources are the DFL, Transfermarkt, and Kicker. The dataset covers all 2,142 games during this period. In line with previous research, I exclude players who played less than 15 minutes and goalkeepers, owing to their distinct tasks and behaviors (Wicker et al., 2022). The final sample includes observations of 1,283 players, resulting in 49,377 player-game observations.

Table I presents the variables and their descriptive statistics. This paper uses *Yellow card, Second yellow card* (resulting in a red card), and (direct) *Red card* to capture the disciplinary actions taken by the referee against players. On average, the players in the sample received a yellow card in 15.1% of their games, while they received a second yellow and direct red card in only 0.04% and 0.03%, respectively.

The focal independent variables in this analysis are player characteristics potentially influencing disciplinary actions (Wicker et al., 2022). Accordingly, I incorporate the variables *Age*, *Distance* covered during a game, *Height*, *Market value*, and two variables controlling for

player nationality: first, whether the player is *German* or non-German, and second, what continent the player is from. I also include *Playing time*, *Position* (defender, midfielder, or forward), *Rest days,* and *Tenure*.

Table I. Descriptive statistics (n=49,377), 2011/2012 – 2017/2018

Variable	Mean	SD	Min	Max
Yellow card	0.1531		0	1
Second yellow card	0.004		0	1
Direct red card	0.003		0	1
Age (in years)	25.986	3.716	17.003	39.633
Distance (in m) per minute	122.693	4.674	105.222	140.156
Height (in cm)	182.928	6.288	163.000	199.000
Market value (in million €)	6.704	6.613	0.825	43.003
German nationality	0.435		0	1
European nationality	0.777		0	1
North American nationality	0.023		0	1
South American nationality	0.076		0	1
Asian nationality	0.064		0	1
African nationality	0.056		0	1
Australian nationality	0.003		0	1
Playing time	76.726	22.423	15.000	90.000
Position-Defenders	0.360		0	1
Position-Midfielders	0.327		0	1
Position-Forwards	0.314		0	1
Rest days	10.543	7.695	2.729	79.030
Tenure	3.307	1.144	0.892	7.834
Attendance (in k)	43.523	17.233	13.500	81.360
Derby	0.037		0	1
Difference in win probability (in %)	0.369	0.254	0.000	0.959
Goal difference	1.456	1.273	0.000	8.000
Home game	0.497		0	1
VAR	0.145		0	1

The average age is 26, with the youngest player being 17 and the oldest almost 40. On average, players cover 123 meters per minute, with a minimum of 105 meters/min and a maximum of 140 meters/min. The average height of players in the sample is 182.9 cm, with the smallest player measuring only 163 cm and the tallest measuring 199 cm. Player's market values range from 825'000 to 43 million Euros and average 6.70 million. The sample includes 43.5% of players of German nationality and 56.5% non-German. 77.7% of players are *European*, 2.3% *North American*, 7.6% *South American*, 6.4% *Asian*, 5.6% *African*, and 0.3% *Australian*. The average playing time is roughly 77 minutes. The three position groups are balanced, each having a little more than 30% of the players. Players usually have 10-11 days between two games and have played for their club for 3.3 years on average.

I incorporate six control variables to account for confounding factors (Wicker et al., 2022). First, I include *Attendance* to account for potential social pressure on the referee. Second, I include whether the game is a *Derby* (rivalry game), acknowledging the heightened intensity that could lead to more fouls. Third, I control for the *Difference in win probability* between the two teams playing derived from the betting odds. Fourth, I include the *Goal difference* in the game. Fifth, I control for *Home* bias. Sixth, *VAR* indicates whether Video Assistant Referee was used in the season under study.

I run fixed effects regressions to analyze the dependent variables with the remaining variables from Table I as independent variables. Additionally, I apply fixed effects for club, game day,

head coach, kick-off hour, opponent, referee, season, tactical formation, and weekday to the models and estimate them using heteroscedasticity-robust standard errors.

3. Results and discussion

Table II displays the regression results. I find a significant negative correlation between the more distance a player runs in a game and the likelihood of receiving a yellow card and a second yellow card. The significant coefficients are -0.002 and -0.0002, indicating that for every 10 meters a player runs more per minute, the likelihood of receiving a yellow card decreases by 2% and the likelihood of receiving a second yellow card decreases by 0.2%, respectively. This result is consistent with the findings of Wicker et al. (2022), who examined the effect of running performance at the team level.

Table II. Fixed-effects regression results for yellow, second yellow, and red card (n=49,377)

	(1) *Yellow card*	(2) *Second yellow card*	(3) *Red card*
Age (in years)	0.001	0.000	0.000
	(0.000)	(0.000)	(0.000)
Distance (in m) per minute	-0.002***	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)
Height (in cm)	0.001***	0.000***	0.000*
	(0.000)	(0.000)	(0.000)
Market value (in million €)	-0.001	-0.000	0.000
	(0.001)	(0.000)	(0.000)
German nationality	-0.002	-0.002**	-0.002***
	(0.004)	(0.001)	(0.001)
North American nationality	0.002	-0.001	0.001
	(0.011)	(0.002)	(0.002)
South American nationality	0.038***	0.001	0.000
	(0.007)	(0.001)	(0.001)
Asian nationality	-0.024***	-0.001	-0.001
	(0.007)	(0.001)	(0.001)
African nationality	0.011	0.000	-0.002
	(0.008)	(0.001)	(0.001)
Australian nationality	0.032	0.002	0.003
	(0.029)	(0.006)	(0.006)
Playing time	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Position-Midfielders	0.026***	-0.001	-0.003***
	(0.004)	(0.001)	(0.001)
Position-Forwards	-0.037***	-0.003***	-0.003***
	(0.004)	(0.001)	(0.001)
Rest days	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Tenure	0.001	-0.000	-0.000
	(0.002)	(0.000)	(0.000)
Controls	Yes	Yes	Yes
FE	Yes	Yes	Yes
R^2	0.025	0.006	0.007

Note: Reference categories for continent: European nationality, for Position: Defenders; heteroscedasticity-robust standard errors in parentheses; *p < 0.1, **p < 0.05, ***p < 0.01

The findings on player height also extend previous research, which suggests that referees tend to call a foul on the taller player in an ambiguous tackle situation (Van Quaquebeke & Giessner, 2010), but also align with embodiment research. This research connects height to perceptions of strength, power, and aggression, providing a potential mechanism for these findings (Lakoff & Johnson, 2008). The magnitudes of the height coefficients indicate that for each 10 cm

increase in a player's height, the likelihood of receiving a yellow card increases by 10%, while the likelihoods of receiving a second yellow card or a red card increase by 1%.

Moreover, I present evidence that German players are (0.02%) less likely to receive a second yellow card and a direct red card, suggesting possible discrimination based on whether a player is German or not. South American players receive more yellow cards than players from other continents (i.e., 3.8% more than European players), while Asian players receive fewer (i.e., 2.4% less than European players).

As expected, the longer a player is on the field, the greater the likelihood of receiving a yellow card. Specifically, the probability of receiving a yellow card increases by 1% for every additional 10 minutes a player spends on the field. The relationship between receiving a second yellow or a red card and playing time is negative (i.e., for every 10 minutes played more, the likelihood decreases by 1%), likely because both result in exclusion from the game.

Furthermore, midfielders have the highest chance of receiving a yellow card, followed by defenders. This observation is logical since midfielders engage in the most duels, while forwards participate in the fewest. Quantitatively, a midfielder is 2.6% more likely to receive a yellow card than a defender and a defender is 3.7% more likely to receive a yellow card than a forward. Additionally, defenders are (0.3%) more likely to receive red cards than players in other positions, as they usually need to make the most critical tackles.

4. Conclusions

The study's findings reveal several biases in disciplinary actions in German soccer stemming from player characteristics, distance covered, height, nationality, playing time, and position. These insights shed light on broader implications for sports fairness and integrity. Future research could explore whether similar biases exist in other countries, leagues, and sports to determine the universality of these findings and incorporate additional player characteristics to provide further insights.

In order to eliminate the biases identified in this paper, practical steps are required. These include enhanced referee training to address implicit biases related to height and nationality, as well as the introduction of stricter policies against discriminatory practices. The use of Video Assistant Referee (VAR) to review potentially biased decisions, the development of coaching strategies to mitigate risk factors such as height-related penalties, and the application of data analytics to monitor disciplinary trends can further promote justice in soccer.

This paper not only offers practical insights for stakeholders in the sports ecosystem but also contributes to efforts aimed at creating a less biased sporting world. It highlights specific areas of concern and underscores the importance of refining referee education and training to enhance fairness and objectivity in sports.

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