

**Psychological Dynamics of Performance Crises in Professional Soccer:
Developing and Validating Crisis Indices for Team Performance
Assessment**

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Psychological Dynamics of Performance Crises in Professional Soccer: Developing and Validating Crisis Indices for Team Performance Assessment

Performance crises in professional soccer can have profound psychological and organizational impacts, influencing team cohesion, confidence, decision-making, and stakeholder satisfaction. This study aims to develop and validate three quantitative indices – Relative Position (RP), Linear Rate of Change (LRC), and Exponential Rate of Change (ERC) – to assess team performance relative to expectations and detect the onset of crises. Using data from the 2023–24 Bundesliga season, the indices were applied to analyze patterns of underperformance and their connection to managerial changes, providing insights into the psychological dynamics underlying team crises.

The RP index quantifies a team's position relative to preseason expectations, while the LRC index captures cumulative performance trends over the season. The ERC index emphasizes recent performance momentum, identifying acute downturns that may trigger psychological and structural crises. Results show that the indices are effective in diagnosing both chronic and acute performance issues, with sharp declines in ERC often coinciding with coaching dismissals, reflecting the psychological tipping points of team management decisions.

Illustrative case studies of FC Augsburg and VfL Wolfsburg demonstrated the indices' practical utility, highlighting contrasting patterns of early versus late interventions. Across the league, teams experiencing managerial changes exhibited significant negative trends in all three indices, underscoring their reliability in identifying crises. By integrating psychological momentum, expectation management, and performance analysis, the proposed indices provide a systematic approach to monitoring team performance, understanding the psychological precursors of crises, and enabling timely interventions to mitigate performance downturns.

Keywords: crisis; soccer; expectation, team

Introduction

The analysis of crises in professional soccer is of great importance due to their short-term and long-term impacts on team performance. A crisis can be defined as a significant and often sudden disruption or downturn that threatens the stability, functioning, or success of an individual, group, organization, or system (Williams et al., 2017). Such phases not only lead to financial and sporting losses (Druker & Daumann, 2018; Plumley et al., 2017) but can also undermine the teams' and players' confidence as well as the support of the fans (Wergin et al., 2019; Wergin et al., 2018). Therefore, precise identification and operationalization of these crises are essential to implement timely and effective countermeasures.

The development of crises is a dynamic process often initiated by unmet expectations (Massarella et al., 2018). These unmet expectations can lead to psychological and emotional disturbances within a team, significantly impacting both players and management (Bar-Eli & Tenenbaum, 1989). Understanding how expectations influence the emergence of crises is essential, as it highlights the importance of recognizing early warning signs and the underlying emotional states that may contribute to a crisis. By addressing these unmet expectations and their effects, teams can implement more effective strategies to manage and mitigate the progression of a crisis (Choi et al., 2010).

Several psychological theories underscore the pivotal role of expectations in performance enhancement. Motivation theories such as the self-fulfilling prophecy theory (Rosenthal & Jacobson, 1968), expectancy-value theory (Wigfield & Eccles, 2000), and self-efficacy theory (Bandura, 1997) suggest that when individuals or teams hold strong, positive expectations of success, they are more likely to increase their motivation, focus, and effort, thereby improving outcomes on the field. In contrast,

appraisal theories of emotion, such as Lazarus' (1991) cognitive theory of emotion, Scherer's (2009) component process model, and Carver and Scheier's (1990) control theory of self-regulation, take a broader perspective. These theories view expectations as benchmarks for appraising situations, which then trigger affective processes based on these evaluations. For instance, Carver and Scheier's (1990) control theory posits that individuals regulate their behavior by comparing current performance to their goals or standards. When a negative discrepancy is detected between actual performance and the desired standard, it generates negative affect, motivating individuals to initiate actions to reduce the discrepancy.

In competitive sports, high expectations – especially when unmet – have been identified as significant contributors to competition anxiety (Wiggins & Brustad, 1996), choking under pressure (Hill & Shaw, 2013), spirals of negative emotions (Jekauc et al., 2021), and team collapse (Wergin et al., 2019; Wergin et al., 2018). These phenomena have been shown to negatively impact performance in individual matches or tournaments. Over the course of multiple matches or segments of a season, unmet expectations have also been recognized as triggers of performance crises in team sports (Buenemann et al., 2023). In the context of soccer, Jekauc et al. (2024) demonstrated through a study involving nine professional soccer players that unmet expectations trigger complex psychological processes, leading to negative psychological states such as rumination, reduced self-confidence, increased anxiety, and over-motivation among players. These psychological effects at the individual level can have significant repercussions at the team level, resulting in conflicts, a deteriorating team atmosphere, impaired communication, and reduced cohesion. During matches, this often manifests as a more defensive mindset, a desire to avoid mistakes, and a reluctance to take responsibility, which further exacerbates performance issues. The accumulation of poor

results perpetuates and intensifies the crisis, creating a vicious cycle or downward spiral in which ongoing poor performance reinforces the crisis state (Jekauc et al., 2024).

Psychological momentum is another critical factor in understanding crises in soccer, as it encapsulates the dynamic interplay between performance, perception, and motivation (Morgulev & Avugos, 2023). According to Iso-Ahola and Mobyly (1980), psychological momentum is defined as an added psychological power resulting from a sequence of successes (or failures) that impacts an individual's or team's confidence and performance capabilities. In soccer, psychological momentum can manifest during the season as a team builds upon successive positive events, such as winning matches or making successful plays, leading to an enhanced collective belief in their ability to succeed (Jones & Harwood, 2008). Conversely, a disruption in psychological momentum, such as facing a series of setbacks, can precipitate a performance crisis (Den Hartigh et al., 2014). This disruption undermines the team's confidence and cohesion, leading to a potential downward spiral in performance.

Although existing theories provide valuable insights into the psychological and performance-related processes underlying crises in soccer, they lack specific guidance on how to operationalize such crises. One potential approach to assessing crises would involve directly surveying team members to gain insight into their perceptions and experiences. However, gaining access to professional soccer teams during times of crisis is highly challenging, often rendering this method impractical. Instead, unmet expectations – recognized as a core driver of crises – can be objectively assessed using external data sources such as bookmakers' predictions or team market valuations (Wunderlich & Memmert, 2018). These metrics provide a quantifiable basis for evaluating performance against expectations. Consequently, the development of valid,

implementable crisis indicators tailored to the dynamics of professional soccer is crucial for systematically identifying and addressing performance crises.

The primary aim of this paper is to develop a set of crisis indices tailored to the unique dynamics of professional soccer. These indices are designed to quantify team performance relative to expectations, track cumulative trends over a season, and capture recent psychological momentum. A secondary goal is to provide an initial validation of these indicators by analyzing their interaction and evolution during the 2023–24 Bundesliga season. Through illustrative case studies, the study highlights the practical utility of the indices in diagnosing performance crises and informing managerial decisions, such as coaching changes. This work also contributes to the broader theoretical understanding of performance crises in competitive team sports.

Indicators of Crises in Soccer

Understanding and identifying crises in soccer requires a tailored approach that considers the unique psychological and scoring systems of the sport. Each sport has its own dynamics and competitive structure, which are reflected in how performances are scored and evaluated. When developing a system of crisis indicators for soccer, it is crucial to account for the specific characteristics of the sport, such as the number of tournament competitions in a season, the scoring system in each competition, and the structure of league. For the sake of clarity, we will limit ourselves in this paper to the national league in soccer, as this competition is generally the most important.

Analogous to the description of the movement of a body in physics, where position, velocity, and acceleration are central parameters, the crisis in soccer can be described by three decisive indicators: Relative position in the table, linear rate of change, and exponential rate of change. All three indicators can be defined in terms of

expectations of ranking and success and help to provide a comprehensive assessment of a team's short-term and long-term performance.

Relative Position in the Table

The relative position in the table is a primary indicator of a team's performance within its competitive context. It is calculated based on the total points accumulated from match outcomes – three points for a win, one point for a draw, and no points for a loss. This indicator offers a straightforward view of where a team stands in relation to its competitors. However, the significance of the relative position must be considered in light of pre-season expectations. A team expected to compete for the championship but finding itself mid-table or lower would be considered underperforming, whereas the same position might be satisfactory for a team expected to struggle against relegation. Therefore, the relative position must always be interpreted relative to the team's goals and expectations. The relative position of a team in the table compared to expectations corresponds to the position of an object. This relative position is quantified by the difference between the expected table position and the actual table position, normalized by the number of teams in the league, and can be described by the following formula:

$$RP_{i,t} = \frac{E_{i,t} - A_{i,t}}{N-1} \times 100 \quad (1)$$

where

$RP_{i,t}$ is the relative position of team i on matchday t .

$E_{i,t}$ is the expected table position of team i on matchday t .

$A_{i,t}$ is the actual table position of team i on matchday t .

N is the number of teams in the league.

t is the matchday number.

The relative position coefficient ($RP_{i,t}$) represents the difference between expected and actual position of the team i on matchday t in the table relative to the size of the league. This coefficient varies between 100, if the team with the lowest expected position in the table is at the top of the table, and -100, if the team with the highest expected position in the table is at the bottom. A coefficient of 0 indicates that the team is performing in line with its expectations. This index also considers the size of the league, meaning a deviation in table position must always be viewed relative to the league's size. For example, a drop of three places in the table in a league with 20 teams is less significant than in a league with only 12 teams.

Due to the fact that the deviation between the expected and actual position in the table is divided by the maximum possible improvement or deterioration in the table ($N-1$), this coefficient can be interpreted as the percentage deviation relative to the league size. By normalizing the difference between expected and actual positions and expressing it as a percentage, the relative position provides a clear and comparable metric for performance evaluation across different leagues.

This coefficient can be calculated for each matchday and provides a snapshot of the team's relative position in the table. The relative position in the table, therefore, acts as a fundamental metric for assessing team performance during a season. By comparing the actual position with the expected position, stakeholders can gain insights into whether the team is meeting, exceeding, or falling short of its expected performance. However, in order to describe the dynamics of a crisis, further indicators are needed.

Linear Rate of Change

Similar to the velocity of an object, which indicates the rate of change of position over time, the linear rate of change describes the variation in a team's performance over the course of a season. This rate of change can be measured by the difference between the

points expected per game and the points actually achieved. A consistently negative rate of change indicates that the team is not only underperforming compared to expectations but that this trend is continuing over multiple matchdays. The linear rate of change can be calculated using the summed points difference with the following formula:

$$LRC_{it} = \sum_{t=1}^T (SP_{it} - EP_{it}) \quad (2)$$

where

$LRC_{i,t}$ is the linear rate of change as the summed points difference for team i on matchday t .

$SP_{i,t}$ are the points actually achieved by team i on matchday t .

$EP_{i,t}$ are the points expected for team i on matchday t .

t is the matchday ranging from 1 to the current matchday T .

This equation represents the cumulative difference between actual and expected points up to the current match day and can be interpreted as the sum of the deviations between the points scored and expected points up to match day t . For example, if a team has -10 points, this means that it has scored an average of 10 points less up to matchday t than it was expected to.

The metric for expected points ($EP_{i,t}$) represents the predicted number of points for team i in match t . This expectation should be based on various factors such as historical performance, opponent strength, home advantage, and is often reflected in bookmakers' predictions. For each possible match outcome (win, draw, loss), a probability P is estimated. The sum of the probabilities for the three possible outcomes must equal 100%, thus:

$$P_{win} + P_{draw} + P_{loss} = 1 \quad (3)$$

where

P_{win} is the probability that team i will win match t .

P_{draw} is the probability that team i will draw match t .

P_{loss} is the probability that team i will lose match t .

For instance, if the estimated probabilities for a match are 60% for a win, 20% for a draw, and 20% for a loss, the expected points for the team can be calculated as follows: Multiply the probability of winning (0.6) by the points awarded for a win (3), the probability of drawing (0.2) by the points awarded for a draw (1), and the probability of losing (0.2) by the points awarded for a loss (0). Adding these values together gives the expected points:

$$EP_{i,t} = 3 \cdot 0.6 + 1 \cdot 0.2 + 0 \cdot 0.2 = 1.8 + 0.2 = 2.0 \quad (4)$$

Thus, the expected points for the team in this match would be 2.0. $EP_{i,t}$ indicates how many points a team should earn on average based on the estimated probabilities for the three match outcomes. In general, the LRC index indicates the extent to which the team performs above or below expectations over the course of the season.

Exponential Rate of Change as Psychological Momentum

In sports psychology, psychological momentum refers to the perception and experience of sustained success or failure, which influences the performance and confidence of an athlete or team. A team that wins multiple games in a row can build strong positive momentum, leading to further success. Conversely, a team that repeatedly loses can experience negative momentum, resulting in further performance decline and potential crisis (Den Hartigh et al., 2014).

To quantitatively capture psychological momentum, the exponential rate of change (ERC) is used. This rate gives greater weight to recent games than to those

played earlier in the season, thus reflecting the current dynamics of the team. The formula for the exponential rate of change is:

$$ERC_{i,t} = \sum_{t=1}^T e^{-\frac{1}{2}(T-t)} (SP_{i,t} - EP_{i,t}) \quad (5)$$

where

$ERC_{i,t}$ is the exponential rate of change for team i on matchday t .

$SP_{i,t}$ are the actual points achieved by team i on matchday t .

$EP_{i,t}$ are the expected points for team i on matchday t .

t is the matchday ranging from 1 to the current matchday T .

This formula uses the difference between the actual points ($SP_{i,t}$) and the expected points ($EP_{i,t}$) to quantify a team's success or failure in a match. The significance of this success or failure on matchday t is weighted by the exponential time factor $e^{-\frac{1}{2}(T-t)}$. The exponential weighting in the ERC formula ensures that the point differences from more recent matches exert a greater influence on the ERC index than those from earlier matches. Specifically, the most recent match is weighted with a factor of 1.00, the second most recent with 0.61, the third with 0.37, the fourth with 0.22, and the fifth with 0.13, among others. This rapid decline in exponential weighting renders recent matches significantly more impactful on the index. Consequently, the ERC is highly sensitive to current performance trends and changes, capturing the essence of psychological momentum in a dynamic sporting context.

Compared to the linear rate of change, the exponential weighting allows for a dynamic and current analysis of recent performance. A high positive ECR value indicates that the team has positive momentum, suggesting a series of performances that exceed expectations. Conversely, a high negative ECR value indicates that the team has negative momentum and may be on the path to a crisis or already in one. An ECR value

near zero means that the team has been performing in line with expectations in recent games and exhibits neither positive nor negative momentum.

Integration of the Indicators

The three proposed indicators – RP, LRC, and ERC – form a cohesive framework for analyzing team performance in professional soccer. These metrics offer distinct but complementary insights, enabling a nuanced understanding of both the gradual and acute dynamics of performance crises. The RP index serves as a macroscopic measure of performance by quantifying the deviation of a team’s actual league standing from preseason expectations. The LRC focuses on cumulative performance trends by comparing actual points accrued to expected points over successive matchdays. This metric is particularly useful for detecting subtle, incremental shifts in performance. The ERC emphasizes recent performance by assigning greater weight to outcomes in the most recent matches. By capturing abrupt changes in momentum, ERC provides an early warning for potential tipping points.

When integrated, these indicators create a multidimensional assessment framework that captures both the cumulative and immediate aspects of performance dynamics. For example, a team exhibiting negative RP and LRC values, coupled with a steep ERC decline, may be approaching a severe crisis, warranting urgent managerial decisions. Conversely, a team with an RP near zero could still be at risk if LRC trends negative and ERC flags a sharp downturn, indicating an imminent performance collapse. This integrative approach allows stakeholders – managers, analysts, and psychologists – to diagnose the nature and severity of performance issues with greater precision. By distinguishing between slow-building crises (reflected in negative RP and LRC trends) and sudden collapses (indicated by steep ERC declines), this framework supports proactive decision-making. Tactical adjustments, coaching changes, and psychological

interventions can thus be implemented more effectively, ensuring timely responses to mitigate performance crises.

Validation of the Crisis Indicators in a Case Study

In the context of professional soccer, particularly within the Bundesliga, the suspension or dismissal of a coach during the season is often a salient indicator of an underlying performance crisis (Heuer et al., 2011). The Bundesliga, as one of the top-tier soccer leagues globally, operates within a highly competitive environment where the expectations placed upon teams are immense (Pieper et al., 2012). Given the significant financial investments and the high stakes involved, the performance of a team is under constant scrutiny from management, fans, and the media alike.

When a team consistently underperforms relative to pre-season expectations or falls short of its strategic objectives, such as qualifying for European competitions or avoiding relegation, the pressure on the coaching staff increases substantially (Allen & Chadwick, 2012). In many cases, the decision to suspend a coach is not made lightly but rather as a response to a series of poor results, which may signal a deeper crisis within the team (Koning, 2003). This crisis is often characterized by a significant deviation from expected performance metrics, including league position, points accumulated, and match outcomes. The suspension of a coach mid-season is thus frequently used as a reactive measure aimed at halting a downward trajectory and revitalizing the team's performance (Lago-Peñas, 2011). For our purposes, it serves as a tangible marker of crisis, reflecting the culmination of ongoing issues that have not been resolved through other means. This case study utilizes the suspension of a coach within the Bundesliga as a case study to validate specific crisis indices, demonstrating their effectiveness in identifying and quantifying performance-related crises within a highly competitive sporting environment.

Data Collection

To validate the three crisis indices – PR, LRC, and ECR – we analyzed all instances of coach suspensions in the 1. Bundesliga during the 2023-24 season. Only cases where a coach was suspended during the current season (Matchdays 1 to 34) were included, focusing on mid-season changes indicative of performance crises.

Expected Table Position

The Expected Table Position was determined by combining squad market valuation and final league standings from the 2022-23 season. Market values as of August 15, 2023, the last day of the first transfer period, were obtained from Transfermarkt ([transfermarkt.de](https://www.transfermarkt.de)) and reflect the team's economic potential. Concurrently, final league standings from the 2022-23 season were sourced from official records such as Kicker (www.kicker.de). The expected position was calculated as the average of the market value rank and the previous season's league rank, providing a balanced performance expectation based on economic and historical indicators.

Expected Points

The EP for each match were derived from pre-match betting odds obtained from Oddsportal (www.oddsportal.com). First, betting odds for win, draw, and loss outcomes were converted into implied probabilities using the formula $1/\text{odds}$. Since bookmakers include a margin, probabilities initially summed to more than 100%. To correct this, probabilities were normalized by dividing each by their total sum. Finally, EP was calculated by multiplying the adjusted probabilities with their corresponding points (win = 3, draw = 1, loss = 0) and summing the results. This approach provided a statistically robust estimate of a team's expected points per match.

Data Analysis

The analysis evaluated how the crisis indices captured team performance dynamics during the 2023–24 Bundesliga season and aligned with observable crisis events, such as coaching dismissals. RP, LRC, and ERC values were calculated for all 18 Bundesliga teams on a per-matchday basis using the formulas outlined in the section Indicators of Crisis in Soccer. These calculations, performed in Microsoft Excel, ensured consistency in processing match outcomes and preseason expectations.

The computed indices were summarized with descriptive statistics, including mean, standard deviation, and range, for each team across the season (Table 1). To explore the relationship between index patterns and managerial decisions, we analyzed the eight documented coach dismissals, focusing on RP, LRC, and ERC values immediately preceding these events (Table 2). To provide detailed insights, time-series visualizations were created for two selected case studies: FC Augsburg and VfL Wolfsburg. These teams demonstrated contrasting crisis trajectories, with Augsburg encountering early-season challenges and Wolfsburg facing a late-season downturn. The visualizations traced the evolution of RP, LRC, and ERC over the season (Figures 1 and 2).

Results

This section critically evaluates the efficacy of the three crisis indices in quantifying underperformance, delineating emergent crises, and forecasting coach suspension events in professional soccer. By analyzing their behavior across teams and matchdays, we assess their utility in reflecting long-term deficits and acute performance declines.

Descriptive Overview of All Indices

The analysis of the crisis indices – RP, LRC, and ERC – for the Bundesliga 2023-24 season, as presented in Table 1, highlights substantial heterogeneity in team performance, emphasizing variations in both relative standings and performance trajectories. The RP metric yielded an overall mean of 0.36 with a standard deviation (SD) of 25.90, suggesting that while teams generally aligned with their expected standings, there was notable dispersion. Teams such as Stuttgart (mean RP = 58.48) and Heidenheim (mean RP = 34.43) markedly outperformed their projected positions, whereas Union Berlin (-36.68) and Mainz (-31.83) exhibited pronounced underperformance, underscoring significant deviations from expectations.

The LRC, which encapsulates cumulative performance trends over the season, recorded an aggregate mean of -0.07 (SD = 5.88). This mean implies a general equilibrium in over- and underperformance across the league. Nonetheless, teams like Leverkusen demonstrated exceptional positive LRC values (mean = 11.37), indicating sustained periods of overachievement. In contrast, Mainz (-9.48) and Köln (-7.59) experienced considerable negative LRC values, reflecting persistent and pronounced declines in performance.

The ERC, designed to capture recent performance dynamics and psychological momentum, presented an overall mean of -0.03 (SD = 1.43), indicative of a mean zero momentum across the league and all matchdays. Teams such as Leverkusen (1.47) and Stuttgart (1.00) displayed significantly positive ERC values, denoting robust recent performance. Conversely, Köln (-0.76) and Mainz (-0.91) were characterized by marked negative ERC values, signaling acute performance deterioration.

Coach Suspension Events as Markers of Crisis

The data presented in Table 2 highlight key patterns associated with the eight documented coach dismissals. First, the RP values were uniformly negative or zero, underscoring that teams consistently underperformed relative to preseason expectations or, in cases such as Bochum, performed precisely at the expected threshold. Bochum's expected 15th-place position offered minimal leeway for underperformance in the rankings, further contextualizing their outcome. This consistent deviation from expected rankings signifies systemic underachievement.

Secondly, the LRC metrics were universally negative, reflecting an accumulation of points below expected performance levels leading up to the dismissals. This trend emphasizes the prolonged nature of the underperformance, spanning multiple matchdays, as opposed to transient or isolated downturns.

Most critically, the ERC, which captures recent performance momentum, revealed pronounced declines. In six of the eight cases (Augsburg, Bochum, Mainz on matchday 21, Union on matchdays 11 and 32, and Wolfsburg), ERC values dropped below -2.0 at or immediately preceding the dismissal, signifying sharp negative momentum. Even in the two exceptions where ERC did not breach the -2.0 threshold (Köln at -1.40 and Mainz at -1.30 on matchday 9), the values remained firmly within a negative trajectory and subsequently fell below the -2.0 mark a few matchdays prior to the dismissal. This timing underscores the role of acute performance deterioration in decision-making, as it indicates a critical threshold that likely influenced the dismissals. These results suggest that while persistently negative LRC values and subpar RP scores may signal broader underperformance, it is the acute downturn in ERC, reflecting recent momentum loss, that often aligns most closely with the timing of a coach's dismissal.

Illustrative Case Examples: Augsburg and Wolfsburg

To illustrate the application and interpretive utility of the crisis indices, we present two case examples: FC Augsburg and VfL Wolfsburg. These clubs were selected due to their contrasting timelines for managerial changes during the 2023-24 Bundesliga season, highlighting how crises can manifest and be managed at different stages.

FC Augsburg

FC Augsburg entered the 2023–24 Bundesliga season with moderate expectations, having finished the previous campaign in 15th place. As of the final day of the summer transfer window (August 15, 2023), the team’s market valuation stood at 124.7 million EUR, ranking 12th in the league (www.transfermarkt.de). Based on this valuation and their prior season’s finish, Augsburg's expected table position was estimated at approximately 13.5th place. However, by Matchday 7, Augsburg had accrued only five points and suffered a critical home defeat to newly promoted SV Darmstadt 98, leading to the dismissal of head coach Enrico Maaßen.

At the time of the coaching change, the team had dropped to 15th place in the league standings. The RP index was calculated at -8.8% , indicating substantial underperformance relative to preseason expectations. Concurrently, the LRC fell to -2.57 , reflecting an accumulating deficit in actual points compared to expected points. Most notably, the ERC, which weighs recent performances more heavily, declined sharply to -2.0 , signaling a significant and immediate downturn in form that likely served as a critical tipping point for managerial intervention. Adding to these pressures, Augsburg had already suffered an early elimination from the DFB Cup at the hands of third-division side SpVgg Unterhaching, further compounding dissatisfaction among stakeholders. Together, the negative values of RP, LRC, and ERC – particularly the acute downturn indicated by the ERC falling below -2.0 – highlighted a clear crisis, prompting decisive action by the club’s management.

Vfl Wolfsburg

VfL Wolfsburg entered the 2023–24 Bundesliga season with high expectations after finishing the previous season in 8th place. By August 15, 2023, the squad's market value of €214.1 million ranked 6th in the league, setting an expected table position 7th place. Wolfsburg started strong, earning 12 points and holding 7th place by Matchday 6, with a LRC of +3.43, indicating performance above expectations. However, performance began to decline after Matchday 6, with all three indices showing consistent drops. Between Matchdays 10 and 14, the ERC fell below -2.0 three times, reflecting lapses in short-term momentum. Simultaneously, RP and LRC steadily declined, signaling increasing shortfalls in meeting expectations (see Figure 2).

By Matchday 26, Wolfsburg had fallen to 14th place in the league standings after a home defeat to FC Augsburg, prompting the club to dismiss head coach Nico Kovač. At the time of the suspension, the RP had plummeted to -41.18%, signifying severe underperformance relative to the team's expected league ranking. The LRC reached -8.98, capturing a significant cumulative deficit between actual and expected points. Meanwhile, the ERC dropped to -2.49, underscoring a pronounced and ongoing negative momentum indicative of confidence erosion and recent failures.

Discussion

This study introduced and initially validated three crisis indices to quantify and analyze performance crises in professional soccer. Inspired by concepts in physics, where position, velocity, and acceleration describe the movement of a body, these indices capture distinct facets of team performance, collectively providing a comprehensive framework for assessing and diagnosing crises during a season. The RP index measures deviations from expected league standings, analogous to a team's "position" relative to preseason projections. It highlights persistent underperformance among teams facing

crises, with clear deviations from their anticipated rankings. The LRC index quantifies cumulative performance trends, akin to “velocity,” by reflecting long-term deficits or surpluses in point accumulation. It is particularly effective in illustrating sustained underachievement or overachievement across multiple matchdays. The ERC index, emphasizing recent performance trends and resembling “acceleration,” captures psychological momentum by reflecting short-term shifts in form. It proves especially valuable for identifying acute downturns in team performance that often coincided with pivotal managerial decisions, such as coach dismissals.

The practical application of these indices was demonstrated through case studies of FC Augsburg and VfL Wolfsburg. Augsburg dismissed its head coach early in the season (Matchday 7) following consistent underperformance across all three indices, including an acute ERC decline to -2.0, which likely served as the critical tipping point. In contrast, Wolfsburg delayed managerial intervention until Matchday 26, despite gradual deterioration in RP and LRC and intermittent ERC declines below -2.0. By the time of the coach’s dismissal, Wolfsburg’s indices indicated a severe crisis, with RP at -41.18%, LRC at -8.98, and ERC at -2.49, highlighting sustained and acute underperformance. Across the league, teams experiencing coaching changes exhibited a consistent pattern of negative RP values, significant LRC deficits, and sharp ERC declines prior to dismissals. These results underscore the indices’ effectiveness in quantifying both chronic and acute performance issues, offering a robust diagnostic tool for understanding team dynamics and the timing of managerial interventions.

Theoretical Implications

This study enhances the theoretical understanding of performance crises in professional soccer by integrating psychological, motivational, and performance-based frameworks. The proposed indices bridge theoretical constructs with measurable phenomena,

providing a structured approach to understanding crises. The RP index, quantifying deviations from expected performance, aligns with theories of unmet expectations, such as the self-fulfilling prophecy (Rosenthal & Jacobson, 1968), appraisal theories of emotion (Lazarus, 1991), and self-regulation theories (Carver & Scheier, 1990). By operationalizing abstract concepts into quantifiable deviations, the RP metric links theoretical expectations with actual performance.

The LRC and ERC indices further capture crisis dynamics. The LRC aligns with Hardy's (1996) catastrophe model and Buenemann et al.'s (2023) model for performance crises, as it reflects cumulative performance trends and the accumulation of setbacks. The ERC, emphasizing recent performance and psychological momentum, incorporates insights from motivation theories, such as Iso-Ahola and Mobily's (1980) conceptualization of psychological momentum. By weighting recent results more heavily, the ERC measures how short-term successes or failures shape a team's trajectory and decisions.

This study highlights that acute ERC declines – often below -2.0 – serve as critical tipping points for managerial decisions, such as coach dismissals. This aligns with catastrophe theories in sports psychology (Hardy, 1996), which suggest small changes can lead to dramatic outcomes. Additionally, the findings support the downward spiral model (Jekauc et al., 2024), where crises are perpetuated by negative momentum at individual and team levels. The ERC's utility as a diagnostic tool enhances the understanding of crisis onset and progression, offering quantitative methods to complement qualitative insights in existing literature.

Practical Implications

The findings of this study offer substantial practical value for stakeholders in professional soccer, including team managers, coaches, analysts, and sports

psychologists. The proposed crisis indices provide a data-driven framework for identifying, monitoring, and addressing performance crises, enabling timely and effective interventions. For team management and coaching staff, the indices can serve as diagnostic tools to assess team performance against preseason expectations and detect early warning signs of crises (Bodik et al., 2010). By relying on objective metrics rather than subjective assessments alone, clubs can make more transparent and data-supported decisions.

For sports psychologists, the indices provide an empirical foundation to understand and address the psychological aspects of team performance. Negative momentum, as captured by the ERC, often corresponds to declines in confidence, cohesion, and motivation (Den Hartigh et al., 2014). Early identification of such patterns allows psychologists to implement interventions aimed at bolstering individual and team resilience, reducing anxiety, and fostering a proactive mindset to break cycles of underperformance (Brown et al., 2020).

Lastly, the broader applicability of these indices extends beyond professional soccer. Their adaptability to other team sports with similar competitive structures – such as basketball, hockey, or rugby – positions them as versatile tools for analyzing performance in diverse contexts. Future integration with advanced technologies, such as machine learning algorithms, could further refine the predictive capabilities of these indices, enabling real-time performance monitoring and more proactive decision-making (Herold et al., 2019; Rein & Memmert, 2016).

Limitations and Future Directions

While this study provides a robust framework for quantifying and analyzing performance crises in professional soccer, several limitations must be acknowledged. First, the analysis is limited to data from the 2023–24 Bundesliga season. Although this

provides a comprehensive snapshot of team performance within a single competitive context, broader validation across multiple seasons and leagues is necessary to establish the generalizability and robustness of the RP, LRC, and ERC indices. Expanding the dataset to include additional seasons and leagues, such as those in England, Spain, or Italy, would provide deeper insights into the cross-league applicability of these indices and could be used to predict coaches' suspensions through advanced statistical models, such as survival analysis, allowing for more sophisticated validation of the indices.

Second, the study relies exclusively on league performance data, which limits the scope of the analysis. Other competitions, such as the DFB Cup and international tournaments like the Champions League, Europa League, and Conference League, play a critical role in shaping stakeholder expectations and influencing team dynamics. A team's performance in these competitions may significantly impact perceptions of success or failure, potentially altering the interpretation of crisis indices. Future studies should incorporate data from these competitions to provide a more holistic assessment of team performance and the fulfillment of expectations. Additionally, the reliance on market valuations and bookmaker odds to estimate preseason expectations introduces potential biases and limitations. While these metrics are widely used and provide objective benchmarks, they may not fully capture the nuances of internal team goals, managerial strategies, or unforeseen contextual factors such as injuries or midseason transfers.

Lastly, this study emphasizes the importance of quantitative analysis but does not integrate qualitative aspects of crisis development, such as psychological insights from team members or organizational dynamics within clubs. While the RP, LRC, and ERC indices offer valuable diagnostic tools, understanding the subjective experiences of

players, coaches, and staff could provide additional context to explain the emergence and progression of crises.

Conclusion

This study introduced and validated three crisis indices to provide a quantitative framework for diagnosing performance crises in professional soccer. Inspired by physical principles describing motion, these indices offer a systematic way to evaluate team performance based on preseason expectations, cumulative trends, and short-term momentum shifts. Applied to the 2023–24 Bundesliga season, the indices identified both gradual declines and sudden downturns in performance. The practical utility of the indices was demonstrated through illustrative case studies of FC Augsburg and VfL Wolfsburg, which highlighted the contrasting dynamics of early versus late managerial interventions. limited to data from one season, future research should include additional leagues, seasons, and competitions to enhance applicability.

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