

ORIGINAL ARTICLE**Modeling the Impact of Sports Logo Color Changes on Fan Loyalty Using Artificial Intelligence and Structural Equation Modeling: A Case Study of Tractor, Esteghlal, and Persepolis Football Clubs****Zahra Alipour¹, Seyed Mohammad Kashef^{2*}, Mir Hasan Seyed Ameri³**

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EXTENDED A B S T R A C T**Introduction**

The present study explores the multifaceted relationship between changes in team logo colors and fan loyalty within the context of Iranian professional football clubs, with a specific focus on *Persepolis*, *Esteghlal*, and *Tractor*. Recognizing that visual identity elements-such as logos, colors, and symbols-serve as crucial markers of emotional attachment, this research seeks to understand how modifications in such elements can influence the psychological, emotional, and behavioral responses of football fans. The research was motivated by the observation that even minor visual adjustments can trigger significant reactions from fans, ranging from enthusiasm and renewed interest to dissatisfaction and resistance. Consequently, this study aims to empirically analyze the extent to which logo color alterations affect fan loyalty, drawing from theories of consumer behavior, brand identity, and emotional branding.

Methodology

Data were collected from a sample of 500 students at the Islamic Art University of Tabriz, selected due to their familiarity with design concepts and active engagement with Iranian football culture. A quantitative approach was employed, utilizing a structured questionnaire designed to measure variables such as perceived attractiveness of the new logo color, emotional response to change, trust in club management, and overall fan loyalty. The data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) to identify direct and indirect relationships among variables, and Artificial Neural Networks (ANN) to enhance the predictive accuracy of the findings and capture potential nonlinear interactions. From a theoretical standpoint, this study integrates principles from brand identity theory, social identity theory, and emotional attachment models. The color of a team logo is not merely a visual design element it carries deep symbolic meaning and emotional significance for fans. In football culture, colors serve as powerful identifiers of belonging, representing community, tradition, and shared pride. Altering these colors may, therefore, threaten the sense of identity that fans have constructed around their club. However, strategic changes that align with modern design trends or cultural symbolism may also revitalize fan engagement and renew emotional bonds. This duality formed the core hypothesis of the present research: that the effect of logo color change on fan loyalty is not universally positive or negative, but context-dependent and mediated by fans' emotional and cognitive evaluations.

Findings

The PLS-SEM results revealed substantial variation among the three clubs under study. Among them, Persepolis fans demonstrated the most positive attitude toward logo color modifications. They perceived such changes as a sign of modernization and innovation, suggesting that Persepolis supporters may exhibit higher adaptability to visual rebranding efforts. In contrast, Esteghlal and Tractor fans showed more conservative reactions, with a tendency to associate color changes with a potential loss of heritage and authenticity. The SEM analysis identified emotional attachment, brand trust, and perceived fit of color change as the most influential constructs in predicting fan loyalty. The path coefficients indicated that when fans perceive the new logo color as consistent with the club's traditional identity and values, their loyalty remains stable or even strengthens. Conversely, when the change is perceived as inconsistent or unnecessary, loyalty tends to decline.

To deepen the analysis, an Artificial Neural Network (ANN) model using a multilayer perceptron (MLP) architecture was employed. This approach was chosen for its ability to capture nonlinear relationships that traditional regression-based models might overlook. The ANN model demonstrated a high level of predictive accuracy, confirming the robustness of the PLS-SEM findings. Sensitivity analysis within the ANN model identified emotional attachment and perceived continuity as the two most critical variables affecting loyalty. In essence, while rational evaluation of design quality plays a role, emotional continuity remains the dominant driver of fan behavior. The ANN results also highlighted subtle variations in fan reactions across demographic segments—particularly gender and age—suggesting that younger fans are generally more open to visual changes than older ones, who tend to value tradition and historical symbolism more deeply.

From a practical perspective, these findings offer valuable insights for sports team managers, brand strategists, and graphic designers. First, before implementing visual rebranding initiatives, teams must conduct empirical assessments of fan sentiment to anticipate potential reactions. Understanding the emotional landscape of the fan base allows clubs to tailor communication strategies that frame the color change positively—emphasizing modernization, progress, or cultural resonance rather than detachment from heritage. Second, maintaining elements of visual continuity (for instance, retaining core hues or symbols) can significantly mitigate negative fan reactions. Third, teams can use predictive modeling tools such as SEM-ANN hybrids to simulate fan responses to proposed design changes, thereby enabling data-driven decision-making.

The implications extend beyond football and are relevant to broader brand management and consumer behavior contexts. Sports teams function as symbolic brands whose value lies largely in the emotional and communal attachment of their supporters. Thus, any modification in their visual identity transcends aesthetics—it becomes a socio-cultural event that influences brand equity and stakeholder relationships. The research underscores that color psychology plays a central role in this process. Red, for instance, is commonly associated with energy, passion, and aggression—qualities that align with Persepolis's brand personality—whereas blue, Esteghlal's dominant color, conveys trust and stability. Changes in these colors, even in tone or saturation, can shift perceived brand personality traits and affect the emotional resonance of the logo.

Moreover, the study highlights the methodological advantage of integrating PLS-SEM and ANN. While SEM offers explanatory insights into causal relationships, ANN enhances predictive precision and reveals complex interaction patterns. This hybrid approach thus provides a more holistic understanding of behavioral phenomena like fan loyalty, which is influenced by both rational and emotional processes. The dual-model strategy can serve as a methodological blueprint for future sports marketing and branding research.

Discussion and Conclusion

The findings further suggest that Persepolis's fan base exhibits higher tolerance for visual experimentation, potentially due to its history of successful performance and

dominant position in Iranian football. This success may have fostered a sense of security and trust in the club's management, allowing fans to perceive changes as enhancements rather than threats. Conversely, the relatively mixed performance histories of Esteghlal and Tractor may make their fans more sensitive to changes that could be interpreted as distractions from core identity. Such psychological nuances underscore the need for contextual awareness when making design or branding decisions in sports organizations.

Additionally, this research contributes to the growing body of literature on sports consumer psychology by illustrating how design-related decisions intersect with emotional loyalty and group identity. It demonstrates that loyalty in sports fandom extends far beyond performance-based satisfaction—it is rooted in symbolic identification, visual memory, and cultural continuity. The color of a team's logo acts as a visual anchor for these elements, and changes to it can either reinforce or destabilize fans' sense of belonging.

From an applied standpoint, the study provides actionable recommendations. Clubs planning to revise their logos should adopt a phased communication strategy, involving fan communities early in the design process through surveys, social media polls, or public design previews. Such participatory approaches not only generate valuable feedback but also foster a sense of ownership among fans, thereby reducing resistance to change. Furthermore, collaborations between marketing departments and design professionals trained in cultural semiotics can ensure that color modifications remain symbolically coherent with the club's heritage and ethos.

The broader economic and commercial implications are also noteworthy. Strong fan loyalty directly translates into sustained merchandise sales, higher ticket purchases, and increased engagement on digital platforms. Conversely, poorly received visual changes can lead to fan disengagement and reduced brand equity. By leveraging the insights provided in this study, football clubs can better manage these risks and capitalize on opportunities for brand rejuvenation through carefully planned visual identity strategies.

Finally, this study's methodological rigor and empirical depth position it as a foundational reference for future explorations of design-driven brand perception in sports contexts. It opens new avenues for interdisciplinary research combining marketing science, design psychology, and data analytics. Future studies may expand the model by incorporating variables such as media exposure, social identity strength, or cross-cultural differences in color perception. Additionally, longitudinal studies could assess how fan loyalty evolves over time following logo modifications, providing a more dynamic view of brand adaptation in sports organizations.

In conclusion, this research demonstrates that changes in team logo colors represent a complex interplay between visual design and emotional loyalty. While such changes can potentially rejuvenate brand image and attract new audiences, they must be approached with cultural sensitivity and strategic foresight. The integration of PLS-SEM and ANN provides a powerful analytical framework for capturing both the rational and affective dimensions of fan behavior. Ultimately, by understanding and anticipating fan reactions, sports teams can make informed decisions that balance innovation with tradition—strengthening loyalty, enhancing brand value, and ensuring long-term success in both competitive and commercial arenas.

KEYWORDS

Logo Color Change, Fan Loyalty, Structural Equation Modeling (SEM), Artificial Neural Networks (ANN), Sports Branding, Football Clubs in Iran, Persepolis Football Club, Esteghlal Football Club, Tractor Football Club, Visual Identity, Color Psychology, Brand Attachment, Sports Marketing.

