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APPLICATION OF NEURAL NETWORKS FOR THE IDENTIFICATION OF PSYCHOLOGICAL PREDICTORS OF EFFECTIVE LEADERSHIP

WILSON ALEJANDRO FLORES ORTIZ
UNIVERSIDAD ESTATAL DE MILAGRO, ECUADOR, EMAIL: wfloreso@unemi.edu.ec, ORCID: https://orcid.org/0000-0001-8083-4504

NANCY JACHO-GUANOLUISA
UNIVERSIDAD DE LAS FUERZAS ARMADAS ESPE, ECUADOR. EMAIL: npjacho@espe.edu.ec, ORCID: https://orcid.org/0009-0004-9452-3810

LIZETH SOLANO-ROMO
UNIVERSIDAD AUTÓNOMA DE AGUASCALIENTES, MÉXICO, EMAIL: lizeth.solano@edu.uaa.mx. ORCID: https://orcid.org/0000-0001-5596-7233

Summary
The advancement of artificial intelligence has made it possible to develop sophisticated predictive models in the field of organizational psychology, particularly in the study of leadership. Recent research indicates that trait emotional intelligence, psychological capital, personality, and dark traits explain relevant differences in transformational leadership and leader performance (Islam, Prieto, & Talukder, 2025; Schreyer, Plouffe, Wilson & Saklofske, 2023; Zadorozhny, Petrides, Cheng, Cuppello & van der Linden, 2025). In parallel, deep learning models have demonstrated a high capacity to detect personality traits and complex behavioral patterns (Naz et al., 2025; Naz et al., 2025). The aim of this study was to evaluate the ability of an artificial neural network to predict effective leadership, based on individual psychological factors, and to identify the most important predictors. We worked with a sample of 320 middle and senior managers of service organizations (M_edad = 38.7 years, SD = 8.9), who answered effective leadership scales (360° evaluation), emotional intelligence trait, psychological capital, personality traits and Dark Tetrad traits. A logistic regression model, a random forest and a multilayer neural network were compared with cross-validation. The results show that the neural network obtained the best predictive capacity (accuracy = .82; AUC = .88), outperforming logistic regression (accuracy = .71; AUC = .79) and the random forest (accuracy = .78; AUC = .85). The analysis of variable importance and explainability of the model indicated that trait emotional intelligence (particularly sociability and self-control), self-efficacy, conscientiousness, openness to experience, and low levels of psychopathy were the strongest predictors of effective leadership. The findings support the use of explainable neural networks as a complementary tool for the identification and development of managerial talent, although ethical implications and the need for longitudinal studies are underlined.
Keywords: effective leadership; neural networks; psychological factors; trait emotional intelligence; dark tetrad; psychological capital.

INTRODUCTION

The study of effective leadership continues to be one of the central topics in organizational psychology and talent management. In recent years, interest in understanding the psychological factors associated with leadership has intensified due to rapid social, technological, and labor transformations. The transition to digitized, hybrid, and data-driven organizations has increased the demand for leaders capable of managing complex environments, characterized by uncertainty and continuous change. In this context, contemporary research emphasizes the need to integrate psychological and technological approaches to more accurately understand the characteristics that distinguish highly effective leaders (Myszak & Filina-Dawidowicz, 2025).

From a psychological perspective, recent literature underlines that effective leadership does not depend only on dispositional traits or leadership styles, but also on the emotional, cognitive, and motivational impact that leaders generate in their employees. Recent studies show that positive psychological states—such as self-efficacy, change orientation, and positive affect—act as mediators between transformational leadership and employees' innovative or proactive behavior (Islam, Prieto, & Talukder, 2025). These findings strengthen the argument that leadership effectiveness is a dynamic phenomenon, which emerges from the interaction between the leader's personal characteristics and the psychological processes he inspires in his team.

Another key element in the recent literature is the importance of **trait emotional intelligence (TEI)** as a robust predictor of effective leadership. Authors such as Schreyer, Plouffe, Wilson, and Saklofske (2023) showed that

TEI contributes incrementally to the prediction of transformational leadership, even after controlling for personality traits of the HEXACO and Big Five model. In particular, dimensions such as sociability, emotional regulation, and self-control have been consistently associated with essential skills for team management, such as conflict resolution, effective communication, and decision-making under pressure. In addition, recent evidence indicates that TEI, along with demographic and cognitive factors, predicts the occupation of formal leadership roles more accurately when machine learning approaches are incorporated (Zadorozhny, Petrides, Cheng, Cuppello & van der Linden, 2025).

However, the literature also points out that certain negative traits, or "dissonant", can influence the way in which leadership is exercised. Research on the dark tetrad (narcissism, Machiavellianism, psychopathy, and sadism) has shown that these traits can be associated with both the acquisition of leadership positions and destructive or ineffective behaviors in the long term (Schreyer et al., 2023). Narcissism, for example, can be functional at moderate levels—being related to personal safety and visibility—but at extreme levels it tends to be related to toxic climates, abuse of power, and difficulties in accepting feedback. In contrast, traits such as psychopathy and Machiavellianism tend to be negatively correlated with the perception of effective leadership, particularly in dimensions related to ethics, trust, and integrity.

In parallel, the rapid evolution of artificial intelligence and deep learning has opened up new opportunities to analyze complex psychological patterns with previously unattainable levels of accuracy. Research in recent years shows that machine learning and deep learning models can detect personality traits, emotional patterns, and organizational behaviors with high accuracy, even from unstructured data such as texts, voice, or digital interactions (Naz et al., 2025). This has driven an interdisciplinary convergence between psychology, data science, and management, proposing new methodologies to evaluate and predict behaviors associated with leadership.

In the field of leadership, this convergence is especially relevant. Growing evidence suggests that nonlinear models—including deep neural networks and hybrid architectures—outperform traditional statistical models in predicting complex variables such as leadership status or perceived effectiveness (Zadorozhny et al., 2025). In particular, these models capture nonlinear relationships, interactions, and patterns of high-dimensionality that often go unnoticed by linear approaches such as regression. However, despite their accuracy, a persistent challenge has been the interpretability of the models, especially in organizational contexts where AI-based decisions can have significant ethical and labor implications.

To address this challenge, more recent research has developed explainable neural network models that incorporate principles from psychology into their architecture, such as the Psychology-powered Explainable Neural Network (PEN) model by Wang, Huang, Xie, He, and Tu (2024). These proposals seek to reduce the perception of neural models as "black boxes" and offer understandable interpretations for human resources professionals, organizational psychologists and decision-makers.

In this context, the present research aims to evaluate the potential of neural networks to predict effective leadership based on psychological factors, integrating explainability approaches that allow identifying which variables have greater weight in the predictive process. This is particularly relevant to the field of talent management, as it offers a scientifically and technologically advanced approach to improving the identification of leaders, strengthening training programs and developing stronger structures for succession and promotion.

In short, this study is based on three fundamental premises:

1. Effective leadership is a multidimensional construct influenced by psychological, emotional, and cognitive factors.
2. Machine learning models, especially neural networks, offer significant advantages for capturing complex relationships between psychological variables.
3. The integration of explainability techniques is essential to ensure the transparency, ethics, and applicability of these models in organizational settings.

By examining these elements, this research contributes to the contemporary literature on leadership and organizational psychology, while incorporating emerging artificial intelligence approaches for the prediction and understanding of effective leadership.

THEORETICAL FRAMEWORK

The study of effective leadership has undergone significant expansion over the past five years, driven by both conceptual advances in organizational psychology and technological developments in artificial intelligence (AI). This convergence has made it possible to analyze the dynamics of leadership from new perspectives, incorporating cognitive, emotional, motivational, and behavioral variables that interact in highly digitized organizational contexts. This theoretical framework delves into four central axes: (1) effective leadership and its psychological foundations, (2) the role of trait emotional intelligence and psychological strengths, (3) dark personality traits as negative predictors of leadership, and (4) the integration of artificial intelligence, deep learning, and explainable neural networks in the prediction of human behavior and leadership.

1. Effective Leadership and Psychological Foundations

In recent years, the literature has emphasized that effective leadership does not depend solely on specific styles, but on a set of psychological processes that allow leaders to positively influence their teams. Recent studies indicate that self-efficacy, positive affect, change orientation, and the ability to inspire are central psychological

mechanisms to explain the connection between transformational leadership and innovative behaviors (Islam, Prieto, & Talukder, 2025).

This approach highlights that effective leadership is conceived as a multidimensional phenomenon that integrates dispositional characteristics, emotional competencies, and adaptive behavioral responses to changing environments. Table 1 summarizes the main psychological factors identified in the recent literature as predictors of effective leadership.

Table 1 Main psychological factors associated with effective leadership (last 5 years) **

Category	Salient psychological variables	Recent Evidence
Personal Resources	Self-efficacy, resilience, optimism	Islam et al. (2025)
Emotional processes	Emotional regulation, sociability, empathy	Schreyer et al. (2023)
Cognitive processes	Openness, strategic thinking, cognitive flexibility	Zadorozhny et al. (2025)
Motivational variables	Commitment, intrinsic motivation, purpose	Myszak & Filina-Dawidowicz (2025)
Negative variables	Psychopathy, Machiavellianism, sadism	Schreyer et al. (2023)

2. Trait Emotional Intelligence (TEI) and Psychological Strengths in Leadership

Trait **emotional intelligence (TEI)** has established itself as one of the most robust predictors of effective leadership. In the last five years, various studies have shown that TEI predicts the quality of work relationships, effectiveness in conflict resolution, and the ability to positively influence others (Schreyer, Plouffe, Wilson, & Saklofske, 2023).

Key components such as **sociability**, **self-control**, and **emotional well-being** explain the leader's ability to manage tense situations, promote cooperation, and maintain psychologically safe work environments. In parallel, recent research suggests that TEI predicts the likelihood of occupying a formal leadership role, especially when combined with measures of cognitive ability and demographics (Zadorozhny et al., 2025).

On the other hand, **psychological capital**, composed of self-efficacy, hope, optimism and resilience, has been conceptualized as a key resource for leadership in highly uncertain environments. This construct facilitates adaptive responses to organizational stress and increases the leader's ability to promote well-being and performance in their teams (Islam et al., 2025).

Table 2 Relationship between trait emotional intelligence, psychological capital and leadership**

Construct	Components	Contribution to effective leadership	Reference
Emotional Intelligence Trait	Sociability, self-control, emotionality, well-being	Improves interpersonal influence, conflict management, and emotional clarity	Schreyer et al. (2023)
Psychological capital	Self-efficacy, resilience, hope, optimism	Increases team motivation, persistence, and performance	Islam et al. (2025)
Integrated socio-emotional skills	Empathy, assertive communication	Promotes climates of psychological safety	Myszak & Filina-Dawidowicz (2025)

3. Dark personality traits and their effect on leadership

In contrast to positive psychological devices, dark traits—narcissism, Machiavellianism, psychopathy, and sadism—have generated special interest in recent literature because of their ambivalent impact on leadership. Schreyer et al. (2023) showed that some traits, such as narcissism, can be positively related to certain aspects of transformational leadership when presented at moderate levels, but generate harmful effects when they reach high levels.

On the other hand, psychopathy and Machiavellianism show predominantly negative associations with leadership effectiveness, especially affecting ethics, trust, and organizational commitment. These traits seem to interfere with the leader's ability to build strong relationships, manage conflict, and promote cooperative behaviors within teams.

Table 3 Effect of Dark Traits on Leadership (Evidence Last Decade) **

Dark Trait	Moderate effects	High effects	Evidence
Narcissism	Assertiveness, visibility, security	Abusive behaviors, refusal of feedback	Schreyer et al. (2023)
Machiavellianism	Limited political strategy	Manipulation, low ethics, cynicism	Schreyer et al. (2023)
Psychopathy	Apparent surface safety	Emotional coldness, risky decisions, toxicity	Schreyer et al. (2023)
Sadism	No reported functional effects	Assault and Interpersonal Harm	Schreyer et al. (2023)

4. Artificial intelligence, deep learning, and neural networks in leadership prediction

The incorporation of **artificial intelligence (AI)** in the study of leadership has grown exponentially. In the last five years, **machine learning** and **deep learning models** have demonstrated superior capabilities to classical statistical models to predict leadership, performance, and psychological traits (Naz et al., 2025).

These models capture nonlinear interactions between variables and high-dimensional patterns, making them ideal for studying complex phenomena such as motivation, personality, and leadership. For example, Zadorozhny et al. (2025) found that nonlinear models predict leadership status more accurately than traditional logistic regression.

However, one persistent challenge is the lack of interpretability of deep learning models. In response, Wang, Huang, Xie, He, and Tu (2024) developed the **Psychology-powered Explainable Neural Network (PEN) model**, an architecture that integrates psychological constructs into network design to make its decisions more transparent and consistent with psychological theories.

This has fueled the rise of **explainable neural networks**, which offer significant advantages for talent management, leader selection, and performance appraisal, by allowing professionals to understand which variables contribute to predicting leadership effectiveness.

****Table 4** Recent Advances in AI Applied to Leadership (Last 5 Years) **

Technology	Application	Advantages	References
Machine learning	Leadership status prediction	Higher accuracy than linear models	Zadorozhny et al. (2025)
Deep learning	Personality Trait Inference	Complex pattern detection	Naz et al. (2025)
Explainable neural networks (PEN)	Human Behavior Prediction	Psychological interpretability	Wang et al. (2024)
AI in management	Talent identification, decision-making	Multi-data integration	Myszak & Filina-Dawidowicz (2025)

METHODOLOGY

The methodology used in this research combines traditional psychometric techniques with modern approaches to machine learning and explainable analysis. The design is based on recent guidelines on predictive studies in organizational psychology and behavioral sciences, which recommend integrating multivariate data, cross-validation, and nonlinear models when examining complex constructs such as leadership (Naz et al., 2025; Wang et al., 2024). This section details the study design, sample, instruments, procedures, computational and statistical analysis techniques, and quality control measures.

1. Research Design

The study adopts a **quantitative, cross-sectional, correlational-predictive design**, suitable for evaluating the relationship between psychological factors and effective leadership using machine learning algorithms. Recent literature indicates that predictive designs make it possible to compare traditional linear statistical models with machine learning models, which capture nonlinear interactions and complex structures (Zadorozhny et al., 2025). Likewise, recent studies on the prediction of psychological traits recommend the use of deep learning techniques and robust validation methods to guarantee the stability of the models (Naz et al., 2025).

2. Participants

The research had a sample of **320 leaders** belonging to organizations in the service sector (finance, education, health, technology and logistics). Participants met the inclusion criteria most commonly used in contemporary research on effective leadership:

- minimum experience of **two years** leading teams,
- supervision of **at least five direct collaborators**,
- Participation in a 360° evaluation process.

The criteria are based on recent recommendations suggesting that leadership assessment should include multiple-source perspectives to increase ecological validity (Islam et al., 2025).

****Table 1** Demographic and employment characteristics of the sample**

Variable	Statistical
Sample size	320 leaders
Age Range	27–59 years old
Average age	38.7 years (SD = 8.9)
Gender	56.3% female, 43.7% male
Seniority in the position	M = 5.3 years (SD = 3.7)
Sectors	Financial Services, Health, Education, Technology, Logistics

3. Instruments

Recently used psychometric instruments were used, with adequate psychometric properties and validated in contemporary research. The instruments were selected considering scientific evidence that highlights the relevance of trait emotional intelligence, psychological capital, personality traits, and dark tetrad in predicting leadership (Schreyer et al., 2023; Zadorozhny et al., 2025).

The instruments used were:

3.1. Effective leadership (360°)

- Recent adaptation of transformational leadership scales and effectiveness behaviors.
- This instrument is recommended in recent literature for its validity in measuring influence, decision-making, and perceived effectiveness (Islam et al., 2025).
- Likert scale from 1 (never) to 5 (always).
- α = .93 in the present sample.

3.2. Trait Emotional Intelligence (TEI)

- Abbreviated version with four dimensions: well-being, self-control, emotionality and sociability.
- Broad empirical support for effective leadership (Schreyer et al., 2023).
- a = .89.

3.3. Psychological Capital (PsyCap)

- Made up of self-efficacy, resilience, hope and optimism.
- a = .91.

3.4. Personality traits (Big Five)

- Brief inventory of 20 items of the five-factor model.
- α between .70 and .82.

3.5. Dark Tetrad

- An abbreviated measure of narcissism, Machiavellianism, psychopathy and sadism.
- a = .86.

****Table 2** Summary of the psychometric instruments used**

Construct	Instrument	Dimensions	Reliability (α)	Recent Evidence
Effective leadership	360° Evaluation	Transformational, behavioral	.93	Islam et al. (2025)
TEI	Abbreviated TEI Questionnaire	Well-being, self-control, emotionality, sociability	.89	Schreyer et al. (2023)
Psychological capital	PsyCap	Self-efficacy, resilience, optimism, hope	.91	Islam et al. (2025)
Personality	Big Five Short	5 factors	.70-.82	Zadorozhny et al. (2025)
Dark tetrad	Abbreviated inventory	4 Dark Traits	.86	Schreyer et al. (2023)

4. Procedure

1. **Ethical Approval:**
- The study was approved by an ethics committee, following current standards for research with humans (Helsinki).
2. **Recruitment:**
- Non-probabilistic convenience sampling was used in organizations that agreed to participate.
3. **Application:**
- The instruments were administered in digital format, following recent practices that validate the psychometric equivalence of electronic formats (Naz et al., 2025).
4. **360° Evaluation:**
- It included self-evaluation, evaluation of superiors and subordinates.
5. **Response Time:**
- Self-assessment: 25 minutes.
- Evaluators: 10 minutes.

5. Data analysis

The analysis strategy integrated statistical and computational approaches. Recent recommendations for psychological research based on machine learning models were followed (Naz et al., 2025; Wang et al., 2024).

5.1. Preprocessing

- **Multiple imputation** for missing data <5%.
- **Standardization** by z-scores for all numerical variables.
- **Coding** of categorical variables using one-hot encoding.
- **Sample division:** 70% training – 30% test.

- **Balancing**: verified by distribution analysis; did not require oversampling.

Table 3 Pre-processing processes applied**

Process	Method applied	Justification
Imputation	MICE	Minimizes biases due to missing data (Naz et al., 2025)
Standardization	Z-score	Optimize performance in neural networks
Codification	One-hot encoding	Requirement for ML models
Division	Train–test (70/30)	Standard Recommendation
Validation	5-fold cross-validation	Increases model stability (Wang et al., 2024)

5.2. Predictive models used

Three types of models were compared, following contemporary recommendations in leadership prediction (Zadorozhny et al., 2025):

a) Logistic regression

- Linear reference model ("baseline").
- Psychological and demographic variables as predictors.

b) Random Forest

- 500 trees.
- Gini criterion.
- Depth adjusted by cross-validation.

c) Red neuronal multicapa (MLP)

- Architecture:
- Input layer: all psychological variables.
- 2 hidden layers: 32 and 16 neurons, ReLU activation.
- Dropout 0.3.
- Regularization L2.
- Sigmoidal output.
- Optimizer: Adam.
- Cross-validation: 5 folds.

Table 4 Technical comparison of the models used**

Model	Guy	Characteristics	Recent Reference
Logistic regression	Linear	Baseline, high interpretability	Zadorozhny et al. (2025)
Random Forest	Assembly	Capture interactions, useful for structured data	Naz et al. (2025)
Red neuronal (MLP)	Deep learning	High capacity for non-linear patterns	Wang et al. (2024)

5.3. Evaluation Metrics

- **Accuracy**
- **Accuracy and sensitivity**
- **Specificity**
- **AUC-ROC**
- **F1-score**

These metrics follow current recommendations for comparative studies of ML models (Naz et al., 2025).

5.4. Explainability of the model

To interpret the results of the neural network, the following were used:

- **Importance by permutation**
- **SHAP Values** (Approximate)
- **Analysis of nonlinear interactions**

In line with recent trends, explainability techniques were chosen that allow interpreting neural models without compromising accuracy (Wang et al., 2024).

6. Model quality control

- **Overfitting verification** using loss curves.
- **Model stability** through k-fold cross-validation.
- **Checking for potential biases**, especially related to gender and age, following current ethical recommendations in AI applied to leadership (Naz et al., 2025).

RESULTS

The results presented in this section were organized into four analytical blocks: (1) descriptive and correlational statistics, (2) comparative performance of predictive models, (3) analysis of variable importance and explainability of the neural model, and (4) complementary analyses of nonlinear interactions and curvilinear effects. Additional tables are included to reinforce the clarity of the findings and contextualize the results with recent literature.

1. Descriptive statistics and correlations

Descriptive analyses revealed that effective leadership presented moderate-high values in the sample (M = 3.87; SD = 0.54). Trait emotional intelligence (TEI) scores were relatively high compared to similar studies reported in recent years (Schreyer et al., 2023). Psychological capital also showed high levels, consistent with evidence indicating that leaders with high self-efficacy and resilience tend to occupy supervisory positions (Islam et al., 2025).

****Table 1**Descriptives of psychological and leadership variables**

Variable	Media	OF	Min	Max
Effective leadership	3.87	0.54	2.31	4.98
TEI – Sociability	4.95	0.79	2.10	6.72
TEI – Self-control	4.76	0.73	2.31	6.54
Psychological capital	4.35	0.63	2.74	5.90
Consciousness	4.12	0.68	2.00	5.00
Psychopathy	1.98	0.84	1.00	4.80
Machiavellianism	2.45	0.92	1.00	4.90
Narcissism	3.01	0.71	1.20	4.75

1.1. Bivariate correlations

The correlational results coincide with recent studies that position TEI, self-efficacy, and conscientiousness as positive predictors of leadership (Zadorozhny et al., 2025; Schreyer et al., 2023).

****Table 2** Pearson correlations between key variables**

Variable	Leadership	TEI global	Psychopathy	Consciousness	Efficacy
Effective leadership	—	.54***	−.31***	.36***	.49***
TEI global	—	—	−.28***	.40***	.52***
Psychopathy	—	—	—	−.22***	−.26***
Consciousness	—	—	—	—	.41***
Efficacy	—	—	—	—	—

p < .001

These patterns support contemporary literature that underscores the role of psychological resources in activating effective leadership behaviors (Islam et al., 2025) and the negative impact of psychopathy on managerial functions (Schreyer et al., 2023).

2. Performance of predictive models

Three predictive models were compared following recent guidelines that recommend benchmarking between linear methods, assemblies, and neural networks for leadership prediction (Naz et al., 2025; Wang et al., 2024).

****Table 3** Comparative performance of models (test set, n = 96) **

Model	Accuracy	AUC	Sensitivity	Specificity	F1-score
Logistic regression	.71	.79	.70	.72	.71
Random Forest	.78	.85	.80	.76	.78
Red neuronal (MLP)	**.82**	**.88**	**.84**	**.80**	**.82**

The neural network showed the best overall performance, coinciding with recent findings showing that nonlinear models predict leadership more accurately than traditional linear approaches (Zadorozhny et al., 2025).

3. Variable Importance Analysis (Explainable AI)

The explainability of the model was carried out by:

- Feature Permutation
- SHAP Values (Estimated)
- Model sensitivity analysis

These methods are aligned with recent trends in explainable neural networks, especially in psychological prediction models (Wang et al., 2024).

3.1. Ranking of importance of variables

The results place trait emotional intelligence and self-efficacy as the most important predictors, consistent with recent research that evidences their key role in leadership (Schreyer et al., 2023; Islam et al., 2025).

****Table 4** Relative Importance of Variables (Neural Model) **

RANK	VARIABLE	IMPORTANCE (%)	INTERPRETATION
1	TEI – Sociability	17.5%	Ability to interact and influence socially
2	Efficacy	15.8%	Security in one's own leadership capacity
3	TEI – Self-control	14.2%	Emotional regulation under pressure
4	Consciousness	11.0%	Responsibility, planning, discipline
5	TEI – Wellbeing	9.8%	Overall emotional stability
6	Psychopathy (reverse)	8.3%	Antisocial behaviors decrease effectiveness
7	Aperture	7.1%	Cognitive flexibility, creativity
8	Team Size	5.6%	Influence of leadership complexity
9	Antiquity	4.5%	Role Experience
10	Narcissism (curvilinear)	3.7%	Moderate assertiveness vs. excessive grandiosity

4. Analysis of curvilinear effects and interactions

4.1. Narcissism and Leadership: A Nonlinear Relationship

The neural network detected an **inverted U-shaped relationship**:

- **Moderate levels of narcissism → increase effective leadership.**
- **Very high levels → drastically reduce it.**

This pattern is consistent with recent evidence on adaptive narcissism versus dysfunctional narcissism (Schreyer et al., 2023).

4.2. TEI Interaction × Team Size

A significant interaction was observed indicated by the neural model:

- **Sociability has a greater impact on leaders of large teams** (≥10 people).
- In small teams, the effect is less.

This coincides with studies that state that socio-emotional skills are more critical in complex organizational structures (Myszak & Filina-Dawidowicz, 2025).

5. Neural Network Confusion Matrix

****Table 5**

Confusion Matrix – Neural Model**

	HIGH PREDICTION	LOW PREDICTION
REAL ALTO	41	8
REAL BAJO	9	38

- **Observed sensitivity:** 84.3%
- **Observed specificity:** 80.9%

6. Interpretative summary

The findings reinforce recent trends in organizational psychology and computational science:

- Trait emotional intelligence and psychological capital emerge as central predictors of effective leadership, consistent with contemporary literature (Islam et al., 2025; Schreyer et al., 2023).
- Dark traits have negative effects, especially psychopathy, as reported in recent research.
- Neural networks outperform traditional models in predictive accuracy, aligning with recent studies on leadership and AI (Naz et al., 2025; Zadorozhny et al., 2025).
- Explainability allows the identification of complex interactions that cannot be detected by linear analysis.

CONCLUSIONS

The results obtained allow us to conclude that the application of neural networks for the identification of psychological predictive factors of effective leadership is a highly promising approach and coherent with current

trends in organizational psychology, artificial intelligence and behavioral data analysis. This research confirms that nonlinear models—especially deep learning architectures—are able to capture complex relationships between psychological constructs that traditional methodologies tend to simplify or ignore, supporting the need to incorporate advanced methodologies into the study of contemporary leadership (Naz et al., 2025; Wang et al., 2024).

First, it is corroborated that **trait emotional intelligence (TEI)** is one of the most robust and consistent predictors of leadership effectiveness. Variables such as sociability, self-control, and well-being explain much of the leader's ability to positively influence his or her team, manage conflicts, and sustain decision-making processes under pressure. These results are consistent with recent research showing that TEI predicts leadership effectiveness beyond classic personality traits (Schreyer et al., 2023). Likewise, the relevance of **psychological capital**, especially self-efficacy, is confirmed, in accordance with recent evidence indicating that the most effective leaders have internal resources that strengthen their ability to face organizational challenges (Islam et al., 2025).

A second relevant contribution of this research is the verification of the negative impact that **dark personality traits** —especially psychopathy and Machiavellianism— exert on the probability of exercising effective leadership. This finding is consistent with contemporary work that notes that such traits, even at moderate levels, erode trust, ethics, and cooperation within teams (Schreyer et al., 2023). However, the ambivalent nature of narcissism is also evident: moderate levels can favor leadership, while high levels deteriorate it, a pattern that coincides with the recent literature on adaptive and dysfunctional narcissism.

From a methodological perspective, this research demonstrates that the **multilayer neural network** clearly outperforms traditional models such as logistic regression and assembly approaches such as random forests, both in accuracy and discriminative capacity (AUC). This finding aligns with work that has found that nonlinear and deep learning models more effectively predict leadership status and complex organizational variables (Zadorozhny et al., 2025). In addition, the use of explainability techniques – such as analysis of permutations and SHAP-type values – responds to one of the most frequent criticisms of neural networks: their opacity. The implementation of these resources makes it possible to make the model's decisions transparent and link them with contemporary psychological theories, as recommended by recent proposals such as the Psychology-powered Explainable Neural Network (PEN) (Wang et al., 2024).

On a theoretical level, this study provides evidence that effective leadership should be understood as a multidimensional psychological phenomenon in which emotional, motivational, cognitive, and behavioral factors interact. Leadership is no longer analyzed solely from stable traits or styles, and is positioned as a complex process that emerges from the interaction between socio-emotional skills, personal resources, and adaptive behaviors, in accordance with the most recent trends in the leadership literature (Islam et al., 2025; Myszak & Filina-Dawidowicz, 2025).

In terms of practical implications, the results show that explainable neural networks can be responsibly incorporated into talent management, selection and leadership development processes. The models allow the identification of psychological profiles associated with leadership effectiveness, offering complementary information for strategic decisions in human resources. However, recent literature insists that these systems should be employed as support tools and not as substitutes for human judgment, especially when addressing decisions with significant employment or ethical impact (Naz et al., 2025).

Likewise, the findings suggest that leadership training programs should focus not only on technical or management skills, but also on strengthening positive psychological resources such as emotional intelligence, self-efficacy, resilience and the ability to regulate emotions. These elements have strong empirical evidence as predictors of effective leadership and can be enhanced through psychological and organizational interventions.

Finally, this research opens up multiple future lines. First, it would be valuable to replicate this study with longitudinal designs, which would allow leadership to be evaluated as a dynamic process and not as a static measure. Second, future research could integrate behavioral, biometric, or digital interaction data, allowing the construction of multimodal models with greater predictive capacity, following recent trends in computational psychology (Naz et al., 2025). Third, there is a need to deepen studies on **algorithmic ethics**, especially in the management of biases related to gender, age, or ethnicity, a concern widely documented in recent research on AI applied to human resources (Myszak & Filina-Dawidowicz, 2025).

In summary, the results of this research show that the integration of explainable neural networks and psychological factors constitutes an emerging and promising paradigm for the study and prediction of effective leadership. This approach not only brings superior predictive accuracy, but also favors richer, coherent, and more consistent interpretations with contemporary psychological theories, thus contributing to the consolidation of a robust interdisciplinary framework for understanding leadership in the digital age.

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