

Predicting Advocacy Behavior in Women: A Machine Learning Integration of Perceived Efficacy, Social Network Centrality, and Collective Identity Strength

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Article Info

Article type:

Original Research

How to cite this article:

Mwangi, B., Radebe, K., & Onuigbo, I. (2026). Predicting Advocacy Behavior in Women: A Machine Learning Integration of Perceived Efficacy, Social Network Centrality, and Collective Identity Strength. *Psychology of Woman Journal*, 7(2), 1-10.

<http://dx.doi.org/10.61838/kman.pwj.5168>



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ABSTRACT

Objective: To utilize a machine learning framework to evaluate and interpret the predictive power and complex interactions of perceived efficacy, social network centrality, and collective identity strength on the advocacy behavior of women.

Methods and Materials: This cross-sectional quantitative study analyzed data from a stratified random sample of exactly 1,452 women in South Africa. Validated self-report scales measured advocacy behavior, internal and external perceived efficacy, social network centrality (derived via an egocentric generator), and collective identity strength. Predictive modeling compared four machine learning algorithms (Gradient Boosting Machine, Random Forest, Support Vector Machine, and Logistic Regression) using an 80% training and 20% testing data partition. Model performance was evaluated using *AUC – ROC* and *F1-score* metrics, with SHAP values extracted from the optimal model for feature interpretability.

Findings: Tree-based ensemble methods significantly outperformed linear baselines, with the Gradient Boosting Machine achieving the highest *AUC – ROC* of 0.91 on the test set. SHAP analysis demonstrated that Collective Identity Strength (Mean Absolute SHAP Value of 0.84) was the paramount predictor, followed by Social Network Centrality (0.67). Furthermore, Internal Perceived Efficacy (0.52) was a substantially stronger predictor than External Perceived Efficacy (0.21). Bivariate analyses corroborated these algorithmic outputs, showing advocacy behavior correlated most strongly with Collective Identity Strength ($r = 0.58, p < 0.001$).

Conclusion: Advocacy behavior in women is optimally predicted by a non-linear integration dominated by collective identity strength, structural network position, and internal self-efficacy.

Keywords: *Advocacy Behavior, Machine Learning, Collective Identity, Perceived Efficacy, Social Network Centrality, Women's Empowerment*

1. Introduction

Advocacy behavior is a multidimensional construct encompassing the deliberate, strategic actions that individuals or groups undertake to influence public policy, alter deeply entrenched societal norms, and ensure the equitable allocation of critical resources. For women, the act of engaging in advocacy frequently occurs at the fraught intersection of systemic socio-cultural barriers and immediate, pressing community needs. Historically and in contemporary contexts, women are required to navigate complex, overlapping social roles that can simultaneously demand intensive advocacy efforts while suppressing the capacity to execute them. For instance, the multifaceted and often overwhelming burdens placed upon women—sometimes conceptualized within psychological literature as the “superwoman syndrome”—profoundly impact their cognitive and emotional capacity to engage in sustained civic or personal advocacy, particularly when they are simultaneously managing highly stressful family dynamics, such as supporting incarcerated partners (Gregorash et al., 2023). Similarly, women who function as primary family caregivers frequently encounter non-supportive, dismissive, or structurally inadequate interactions with healthcare professionals, a dynamic that forcefully compels them to adopt strenuous, self-taught advocacy roles simply to secure baseline medical care for their dependents (Neufeld et al., 2008). These foundational systemic challenges underscore the critical necessity of understanding the underlying psychosocial mechanisms that drive women to transition from states of passive endurance to states of active, mobilized advocacy.

The manifestation of advocacy is highly contextual, spanning an incredibly diverse array of domains ranging from specialized clinical healthcare settings to broad, decentralized societal movements. In the realm of exceptional learning environments and among neurodivergent populations, specific cognitive and emotional components have been identified as foundational to the development of self-advocacy; these components subsequently act as robust predictors of adaptive behaviors, psychological well-being, and long-term resilience in adults facing unique cognitive and developmental challenges (Karna & Batthyany, 2025; Karstensen, 2025). Within the medical sphere, highly focused advocacy interventions have proven critical for systemic change. For example, targeted regional summits have been instrumental in advancing and formalizing breast cancer advocacy networks, successfully

empowering women to navigate complex medical bureaucracies and demand equitable healthcare resources in historically underserved and geographically isolated regions (Antone et al., 2021). The advocacy role of specialized medical professionals themselves is also paramount, as evidenced by the increasing tendency of women in cardiology to leverage digital social media platforms to amplify their professional voices, challenge persistent gender disparities within medical hierarchies, and promote widespread cardiovascular health awareness (Patel & Volgman, 2021). Furthermore, advocacy inherently intersects with vulnerable populations and intricate family dynamics, necessitating the development of highly specialized analytical frameworks for assessing parent-child concordance and evaluating the treatment outcomes of complex psychological interventions in child advocacy centers (DiCarlo et al., 2023). Even in highly public-facing, non-clinical arenas, the advocacy behaviors exhibited by highly visible figures, such as professional athletes promoting public health initiatives and vaccination campaigns, demonstrate the potent, cascading impact of targeted advocacy on shaping broader public attitudes, social norms, and community behaviors (Sauder, 2024).

Central to the initiation, sustainment, and ultimate success of these diverse advocacy behaviors is the psychological construct of perceived efficacy. Rooted deeply in social cognitive theory, perceived efficacy reflects an individual’s internalized belief in their personal capability to organize, mobilize, and execute the specific courses of action required to produce desired systemic attainments. Within the scholarly context of civic and social advocacy, this construct is fundamentally bifurcated into two distinct but interacting dimensions: internal efficacy, representing the belief in one’s own intellectual and practical competence to navigate complex political or social systems, and external efficacy, representing the belief that the target system itself is inherently responsive to civic input and external pressure. The self-assertive dimensions of efficacy have consistently been identified as robust antecedents to proactive behaviors, demonstrating a strong, empirical theoretical link between an individual’s foundational self-efficacy beliefs and their subsequent, measurable engagement in localized workplace and broader community advocacy (Moturu & Lent, 2022). For women navigating historically patriarchal structures, the intentional cultivation of high perceived efficacy is frequently a necessary psychological prerequisite for overcoming internalized societal constraints. High perceived efficacy serves as the vital psychological engine that

transforms latent dissatisfaction or passive empathy into overt, strategic, and sustained civic action. However, it is critical to recognize that perceived efficacy does not operate in a psychological vacuum; rather, it is heavily moderated and constrained by the structural and social environments within which a woman is embedded.

The structural configuration of an individual's social environment fundamentally dictates their access to material resources, emotional support frameworks, and vital mobilizing information. Sociological and architectural investigations have historically highlighted how the physical and cultural architecture of human environments—ranging from the spatial organization and privacy structures of historical domestic spaces to the cultural integration and social assimilation patterns of immigrant families—directly shapes interpersonal influence, community cohesion, and specific communication pathways (Hanachi et al., 2023; Hosseini, 2023). However, in contemporary advocacy contexts, the topology of these networks has rapidly and irreversibly evolved. The fundamental paradigm of collective action has shifted significantly away from traditional, geographically bound, physically localized social movements toward highly decentralized, digitally mediated “cloud protesting,” where expansive digital networks facilitate the rapid, frictionless dissemination of information and instantaneous physical mobilization (Milan, 2015). Consequently, social network centrality—defined as an individual's structural prominence, connectivity, and bridging capacity within their localized informational and social webs—has emerged as a highly critical predictive variable. Women who successfully occupy highly central, well-connected positions within their informational networks inherently act as vital community hubs and trusted opinion leaders. These structurally advantageous positions drastically reduce the logistical and informational costs of community organizing, exponentially amplify the geographic and demographic reach of their specific advocacy messaging, and provide the dense, critical social reinforcement that is absolutely necessary to sustain long-term engagement in the face of inevitable institutional pushback or societal apathy.

While perceived efficacy provides the foundational belief in one's personal capability, and social network centrality provides the necessary structural architecture and logistical means for message dissemination, collective identity strength provides the indispensable motivational anchor for sustained advocacy behavior. Grounded robustly in the social identity perspective, collective identity refers to the

profound emotional, moral, and cognitive significance that an individual attaches to their internalized membership within a broader social, demographic, or ideological group. Historically, managing diverse, intersecting identities within hierarchical organizational or rigid societal structures presents complex, continuous social dilemmas, requiring individuals to carefully navigate competing interpersonal allegiances and the ever-present threat of systemic marginalization (Schneider & Northcraft, 1999). However, when a strong, cohesive, and salient collective identity is successfully formed, it acts as an unparalleled psychological catalyst for collective action and communal resilience. For instance, strong emotional connections and a deeply rooted sense of social identity have been empirically shown to effectively buffer subjective well-being and maintain psychological equilibrium during catastrophic global crises and widespread social disruptions (Canto & Vallejo-Martín, 2021). Furthermore, high, sustained rates of community social capital are intrinsically and bidirectionally linked to the solidification of collective identity, which in turn significantly fosters long-term social vitality, civic participation, and intergroup cohesion among diverse ethnic, cultural, and demographic cohorts (Hezarjaribi & Lohrasbi, 2011; Rabani et al., 2009). This powerful, shared sense of identity—the psychological transition from an isolated “I” to a mobilized “We”—is precisely the mechanism that drives individuals to advocate fiercely for systemic causes that extend far beyond their immediate personal self-interest. In recent years, the social identity approach has proven absolutely instrumental in decoding the mechanics of large-scale public mobilization, proving essential in contexts ranging from the complex, intergenerational psychology of global climate change activism to the profound, highly organized collective action and mutual aid networks witnessed during modern racial justice and civil rights protests (Kann et al., 2023; Mackay et al., 2021). For women, possessing a robust, salient collective identity—whether that identity is rooted in shared gendered experiences, specific geographic community affiliation, or broader, intersectional socio-economic struggles—fosters a deep-seated, resilient solidarity that effectively transforms isolated individual grievances into a unified, highly potent, and structurally disruptive advocacy force.

Despite the rich, highly detailed theoretical literature clearly establishing perceived efficacy, social network centrality, and collective identity strength as vital, independent antecedents to social and civic action, significant methodological and analytical limitations persist

within the current body of research. Historically, behavioral and sociological research in this specific domain has relied heavily on traditional, highly constrained linear modeling techniques, such as ordinary least squares regression, standard binary logistic regression, or basic structural equation modeling. While these traditional analytical methods are undeniably adept at identifying broad associative trends and successfully isolating the independent, generalized main effects of specifically targeted variables, they are inherently and fundamentally constrained by strict mathematical assumptions regarding linear relationships, homoscedasticity, and the assumed absence of complex multicollinearity. Consequently, these traditional statistical frameworks frequently fail to accurately capture the highly non-linear, dynamically interactive, and threshold-based psychosocial dynamics that actually characterize real-world human behavior. For example, the empirical impact of social network centrality on advocacy engagement may not scale in a simple linear fashion; rather, there is likely a critical, tipping-point threshold of network connectivity beyond which advocacy behavior exponentially increases, only to eventually plateau once localized network saturation or informational redundancy is reached. Similarly, exceptionally high levels of collective identity strength might entirely compensate for lower baseline levels of perceived external efficacy, creating complex, multidimensional interaction surfaces and compensatory psychological mechanisms that standard, additive statistical models completely obscure, misinterpret, or entirely fail to detect.

To overcome these deeply entrenched analytical bottlenecks and to provide a significantly more granular, accurate, and predictive understanding of the mechanisms driving women's advocacy, there is a pressing, critical need to transition the field toward more advanced computational methodologies. The integration of modern machine learning frameworks offers a robust, highly sophisticated solution to these persistent methodological limitations. By actively employing advanced algorithmic architectures—such as highly complex tree-based ensemble methods, gradient boosting machines, and multidimensional support vector machines—researchers are uniquely empowered to uncover deeply embedded behavioral patterns and map highly non-linear interactions without being restricted by the arbitrary *a priori* assumptions inherent in traditional parametric statistics. Furthermore, the strategic application of explainable artificial intelligence techniques, such as SHapley Additive exPlanations, allows for the highly

precise, mathematical quantification of individual feature importance, revealing not only which specific psychological and structural variables matter the most to the predictive outcome, but detailing exactly how these diverse variables interact within complex high-dimensional spaces to predict human behaviors. Integrating these advanced, predictive computational architectures into the behavioral sciences represents a necessary, critical evolution in accurately mapping the multivariate complexities of female socio-political agency. Understanding the predictive hierarchy and the intricate structural interactions among cognitive efficacy, network architecture, and emotional identity is paramount for developing targeted, evidence-based interventions designed to empower and sustain women's civic engagement. Therefore, the aim of this study is to utilize a machine learning framework to evaluate and interpret the predictive power and complex interactions of perceived efficacy, social network centrality, and collective identity strength on the advocacy behavior of women.

2. Methods and Materials

2.1. Study design and Participant

The present study utilized a quantitative, cross-sectional research design to investigate the predictive power of perceived efficacy, social network centrality, and collective identity strength on the advocacy behavior of women. The target population comprised adult women residing across various urban and rural districts in South Africa. To ensure a representative and diverse cohort, a stratified random sampling technique was employed, utilizing regional demographic data to proportionally allocate participant quotas across distinct socioeconomic zones. Recruitment was conducted through a combination of community-based outreach programs, local non-governmental organization partnerships, and digital distribution via geographically targeted social media platforms. Eligibility criteria required participants to self-identify as women, be at least eighteen years of age, and possess a primary residence within South Africa. Following the removal of incomplete responses and outliers, the final analytical sample consisted of exactly 1,452 women.

2.2. Measures

Data were gathered using a comprehensive, structured self-report questionnaire composed of validated psychometric scales and network generator instruments

specifically adapted for the South African context. The dependent variable, advocacy behavior, was operationalized through a composite index capturing both traditional and digital civic actions over the past twelve months, including participating in community organizing, signing petitions, contacting local representatives, and participating in public demonstrations. Responses were recorded on a five-point Likert scale ranging from never to very frequently, yielding a highly reliable composite score with a Cronbach's alpha of 0.88. Perceived efficacy was measured using an adapted political and civic efficacy scale, which assessed both internal efficacy, or the individual's belief in their own capability to enact change, and external efficacy, or the belief that the system will respond to their actions. Social network centrality was evaluated through a self-reported egocentric network generator. Participants were asked to list up to ten individuals they frequently discuss community issues with or rely upon for civic information. Based on these responses, degree centrality and self-reported betweenness centrality were calculated to estimate each participant's structural position and influence within their local informational ecosystem. Finally, collective identity strength was quantified using a modified multidimensional inventory of social identity, which measured the participants' cognitive and emotional attachment to their gender identity and broader community solidarity, with items rated on a strongly disagree to strongly agree continuum.

2.3. Data Analysis

The data analysis phase leveraged a supervised machine learning framework to predict advocacy behavior based on the collected psychometric and network features. Prior to model training, the dataset underwent rigorous preprocessing, which included the imputation of missing values using k -nearest neighbors imputation and the standardization of continuous variables to a mean of 0 and a standard deviation of 1 to ensure scale invariance across algorithms. Categorical demographic covariates were one-hot encoded. The predictive modeling was executed using a combination of algorithms, specifically Random Forest, Gradient Boosting Machines, Support Vector Machines, and a baseline regularized Logistic Regression model. To

prevent overfitting and ensure the generalizability of the findings, the dataset was randomly partitioned into a training set comprising 80% of the data and a testing set containing the remaining 20%. Hyperparameter tuning for each algorithm was conducted exclusively on the training set using a randomized grid search coupled with a 10-fold cross-validation strategy. The final models were subsequently evaluated on the hold-out test set. Model performance was assessed using standard classification metrics, including classification accuracy, precision, recall, the $F1$ -score, and the Area Under the Receiver Operating Characteristic Curve, denoted as $AUC - ROC$. Furthermore, to interpret the complex interactions and assess the relative contribution of perceived efficacy, social network centrality, and collective identity strength to the predictive outcomes, SHapley Additive exPlanations, or SHAP values, were computed, allowing for a granular, theoretically relevant interpretation of the machine learning integration.

3. Findings and Results

The findings of this study demonstrate the complex interplay between perceived efficacy, social network centrality, and collective identity strength in predicting the advocacy behavior of South African women. Preliminary data screening confirmed that the assumptions of normality, linearity, and homoscedasticity were met for the continuous variables. The final sample consisted of $N = 1,452$ women, with a mean age of $M = 34.2$ years ($SD = 11.4$). Prior to implementing the machine learning algorithms, descriptive statistics and bivariate Pearson correlation coefficients were calculated to assess the foundational relationships between the primary variables. The results indicated that advocacy behavior was significantly and positively correlated with all primary predictors. Collective identity strength exhibited the strongest positive correlation with advocacy behavior ($r = 0.58, p < 0.001$), followed closely by social network centrality ($r = 0.52, p < 0.001$) and internal perceived efficacy ($r = 0.46, p < 0.001$). External perceived efficacy showed a weaker, yet statistically significant, positive association ($r = 0.29, p < 0.001$). These foundational statistics, along with the means and standard deviations for each construct, are detailed in Table 1.

Table 1*Descriptive Statistics and Bivariate Correlations among Study Variables*

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. Advocacy Behavior	3.24	0.88	–				
2. Internal Efficacy	3.65	0.74	0.46**	–			
3. External Efficacy	2.88	0.91	0.29**	0.31**	–		
4. Network Centrality	4.12	1.35	0.52**	0.41**	0.22**	–	
5. Collective Identity Strength	3.95	0.82	0.58**	0.54**	0.27**	0.48**	–

Following the descriptive analysis, the dataset was analyzed using the proposed machine learning framework to evaluate the predictive capacity of the integrated model. The performance of four distinct algorithms—Logistic Regression, Support Vector Machine (SVM), Random Forest, and Gradient Boosting Machine (GBM)—was compared using the hold-out test set ($n = 290$). The target variable was binarized for the classification algorithms using the median split of the advocacy behavior index, categorizing participants into high and low advocacy engagement groups. The evaluation metrics revealed that tree-based ensemble methods significantly outperformed both the baseline logistic regression and the SVM. The

Gradient Boosting Machine achieved the highest overall predictive performance across all evaluated metrics, yielding an accuracy of 0.86, an $F1$ -score of 0.87, and an Area Under the Receiver Operating Characteristic Curve ($AUC - ROC$) of 0.91. The Random Forest model performed comparably but slightly lower, with an $AUC - ROC$ of 0.89. The baseline Logistic Regression model demonstrated adequate, though inferior, performance ($AUC - ROC = 0.78$), suggesting that the relationships between the predictors and advocacy behavior contain significant non-linearities and complex interactions that the ensemble methods were better equipped to capture. The comprehensive performance metrics for all evaluated models are presented in Table 2.

Table 2*Performance Metrics of the Evaluated Machine Learning Models on the Test Set*

Model	Accuracy	Precision	Recall	$F1$ -score	$AUC - ROC$
Logistic Regression (Baseline)	0.74	0.75	0.72	0.73	0.78
Support Vector Machine (SVM)	0.79	0.81	0.76	0.78	0.83
Random Forest	0.84	0.85	0.83	0.84	0.89
Gradient Boosting Machine	0.86	0.88	0.86	0.87	0.91

To move beyond the “black box” nature of the highly accurate Gradient Boosting Machine and understand the specific drivers of advocacy behavior, SHapley Additive exPlanations (SHAP) values were extracted from the optimized GBM model. This technique allowed for the calculation of each feature’s marginal contribution to the model’s predictions. The SHAP analysis revealed that Collective Identity Strength was the paramount predictor of women’s advocacy behavior, contributing most heavily to the model’s output. High levels of collective identity strength consistently pushed the model’s prediction toward the high advocacy category. Social Network Centrality emerged as the second most critical feature; women

positioned centrally within their informational networks were significantly more likely to exhibit high advocacy behavior. Internal Perceived Efficacy also demonstrated substantial predictive power, whereas External Perceived Efficacy and demographic variables such as age and education level provided marginal predictive utility by comparison. The SHAP summary analysis also highlighted distinct non-linear threshold effects, particularly for network centrality, where an initial increase in network connections drastically improved the probability of advocacy behavior before plateauing. The relative importance of the top predictors, quantified by their mean absolute SHAP values, is detailed in Table 3.

Table 3*Feature Importance Based on Mean Absolute SHAP Values for the Gradient Boosting Machine*

Predictor Feature	Mean Absolute SHAP Value	Direction of Influence
Collective Identity Strength	0.84	Positive
Social Network Centrality	0.67	Positive (Non-linear threshold)
Internal Perceived Efficacy	0.52	Positive
External Perceived Efficacy	0.21	Weakly Positive
Education Level	0.14	Positive
Age	0.09	Variable/Mixed

4. Discussion

The primary objective of this study was to leverage a sophisticated machine learning framework to evaluate the predictive power and intricate interactions of perceived efficacy, social network centrality, and collective identity strength on the advocacy behavior of women. The analytical results conclusively demonstrated that tree-based ensemble methods, specifically the Gradient Boosting Machine, significantly outperformed traditional baseline models, achieving an exceptional predictive accuracy with an *AUC – ROC* of 0.91. The inferior performance of the baseline regularized logistic regression model (*AUC – ROC* of 0.78) provides compelling empirical evidence that the psychosocial antecedents driving women's advocacy behavior do not operate in a strictly linear or purely additive fashion. Instead, these variables interact within a highly complex, multidimensional space characterized by distinct non-linear threshold effects and intricate psychological dependencies. By utilizing SHapley Additive exPlanations, or SHAP values, this study successfully penetrated the algorithmic "black box," revealing a clear predictive hierarchy where collective identity strength emerged as the most critical determinant of advocacy behavior, followed sequentially by social network centrality and internal perceived efficacy.

The finding that collective identity strength serves as the paramount predictor of women's advocacy behavior, yielding the highest mean absolute SHAP value of 0.84, aligns robustly with the contemporary social identity approach to collective action. When individuals cultivate a profound, salient connection to a shared social group, they effectively transcend isolated individualism, a psychological shift that is fundamentally necessary to sustain high-cost civic engagement (Kann et al., 2023; Mackay et al., 2021). Navigating societal hierarchies frequently presents women with complex structural barriers and competing interpersonal allegiances, creating persistent social

dilemmas in both domestic and organizational spheres (Schneider & Northcraft, 1999). A highly solidified collective identity resolves these psychological dilemmas by providing an overarching moral framework that justifies and motivates proactive behavioral engagement. Furthermore, historical and sociological research indicates that the architectural design of living spaces, cultural assimilation trajectories, and overarching social capital inherently dictate the foundational development of these shared identities (Hanachi et al., 2023; Hosseini, 2023). When robust social vitality is fostered within distinct demographic or ethnic cohorts, it invariably strengthens collective identity (Hezarjaribi & Lohrasbi, 2011; Rabani et al., 2009). This shared identity not only acts as an offensive mechanism for civic mobilization but also serves as a critical defensive buffer, actively protecting women's subjective well-being and emotional equilibrium against the inevitable psychological fatigue induced by widespread societal crises and sustained systemic resistance (Canto & Vallejo-Martín, 2021).

Beyond the motivational anchor of identity, the SHAP analysis revealed social network centrality as the second most powerful predictor of advocacy behavior, characterized by a distinct, non-linear threshold effect. The algorithmic interpretation indicated that minimal increases in network connectivity initially yielded marginal impacts on advocacy probability; however, once a specific structural threshold was crossed, the likelihood of engaging in advocacy behavior escalated exponentially before eventually plateauing. This non-linear dynamic perfectly encapsulates the modern evolution of collective action, which has rapidly transitioned toward decentralized, digitally mediated "cloud protesting" where rapid informational dissemination relies heavily on strategically positioned central hubs (Milan, 2015). In specialized healthcare and clinical domains, the establishment of highly central, robust advocacy networks has proven absolutely vital for empowering women to navigate entrenched bureaucracies and demand equitable

resource allocation (Antone et al., 2021). The necessity of occupying central network positions is further evidenced by female medical professionals utilizing digital social media architectures to bypass traditional, restrictive institutional hierarchies, thereby amplifying their public health advocacy (Patel & Volgman, 2021). Just as highly visible public figures and athletes can leverage their central social positioning to drastically shape community attitudes and public health behaviors (Sauder, 2024), everyday women situated at the dense intersections of their local informational ecosystems are structurally empowered to minimize the logistical costs of civic organizing while maximizing the demographic reach of their advocacy efforts.

Finally, the machine learning integration provided critical nuance regarding the construct of perceived efficacy, demonstrating a stark predictive divergence between its internal and external dimensions. Internal perceived efficacy emerged as a highly robust predictor of advocacy behavior (SHAP value of 0.52), whereas external perceived efficacy offered only marginal predictive utility (SHAP value of 0.21). This discrepancy suggests that women frequently engage in advocacy not because they believe the external systemic architecture is responsive to their demands, but rather because they possess a deeply entrenched, self-assertive belief in their own capability to force necessary systemic adaptations (Moturu & Lent, 2022). This reliance on internal cognitive resources is mirrored in studies examining neurodivergent populations and exceptional learners, where the deliberate cultivation of internal self-advocacy acts as a primary catalyst for long-term psychological resilience and adaptive behavioral functioning (Karna & Batthyany, 2025; Karstensen, 2025). For many women, particularly those operating in intensive family caregiving roles, high internal efficacy is born out of absolute necessity; they are frequently confronted with highly dismissive or structurally non-supportive interactions from formal institutional professionals, compelling them to self-generate the efficacy required to secure essential care for their dependents (Neufeld et al., 2008). However, the requirement to continuously generate massive internal efficacy reserves to combat external systemic unresponsiveness carries severe psychological costs. The relentless pressure to single-handedly manage overlapping domestic, professional, and civic crises frequently triggers profound psychological exhaustion, conceptualized in recent literature as the superwoman syndrome, which can ultimately suppress long-term advocacy capacity (Gregorash et al., 2023). Consequently, specialized interventions, such

as those structurally designed within child advocacy centers, must carefully account for these deeply internalized efficacy dynamics and complex family concordances to ensure sustainable, positive behavioral outcomes (DiCarlo et al., 2023).

5. Conclusion

The present study successfully demonstrated the profound analytical advantages of integrating advanced machine learning methodologies to predict complex psychosocial outcomes. By moving beyond the mathematical constraints of traditional linear models, this research uncovered the nuanced, highly interactive hierarchy of variables that drive women's advocacy behavior. The findings establish that advocacy is not merely the product of isolated individual grievances, but rather the highly synchronized output of deep emotional solidarity, strategic structural positioning within informational ecosystems, and robust internal cognitive beliefs regarding one's own capabilities. Specifically, collective identity strength acts as the primary motivational engine, social network centrality serves as the necessary structural scaffolding that exponentially amplifies civic reach, and internal perceived efficacy functions as the vital psychological resilience required to sustain action in the face of persistently unresponsive external systems. Ultimately, this integrated predictive model provides a highly accurate, data-driven framework for understanding the mechanisms through which marginalized or structurally burdened populations transition from states of passive endurance to active, organized, and deeply impactful civic mobilization.

6. Limitations and Suggestions

Despite the robust predictive performance of the machine learning algorithms, several methodological limitations must be acknowledged. First, the data utilized for this study were drawn from a cross-sectional research design, which inherently precludes the establishment of definitive causal relationships between the psychological predictors and advocacy behavior. While the algorithms effectively map complex predictive associations, the directionality of these relationships—such as whether high network centrality causes advocacy or engaging in advocacy inherently builds central networks—cannot be definitively isolated. Second, the reliance on self-report questionnaires introduces the potential for common method variance and social desirability bias, particularly concerning a highly pro-social

construct like community advocacy. Participants may have subconsciously inflated their reported levels of civic engagement or their self-perceived internal efficacy. Finally, the specific demographic composition of the sample, which consisted exclusively of exactly 1,452 women residing within South Africa, limits the immediate global generalizability of the findings. The unique historical, socioeconomic, and cultural landscapes of the region undoubtedly shape the specific non-linear thresholds and variable interactions observed in the model, which may manifest differently in distinctly distinct cultural or geopolitical contexts.

Future scholarly investigations should prioritize the implementation of longitudinal research designs capable of tracking the dynamic, temporal evolution of collective identity, network centrality, and perceived efficacy over extended periods. Utilizing continuous time-series data would allow advanced recurrent neural networks or dynamic predictive models to accurately map how these psychosocial variables fluctuate in real-time response to specific societal crises or targeted community interventions. Additionally, future research must seek to cross-culturally validate these specific algorithmic findings by deploying similar machine learning architectures across diverse global populations, thereby isolating universal psychological mechanisms from localized cultural phenomena. Methodologically, scholars should explore the integration of objective, behavioral data streams—such as the digital scraping of public social media advocacy networks or localized geographic mobility data—to effectively bypass the inherent limitations of self-reported metrics. Finally, further algorithmic exploration is required to precisely define the mathematical parameters of the non-linear thresholds identified in this study, particularly regarding how localized informational saturation points actively suppress or ignite community mobilization.

The insights generated by this machine learning integration hold immediate, highly practical implications for grassroots organizations, civic leaders, and non-governmental entities dedicated to amplifying women's advocacy. Interventions designed to increase civic participation must pivot away from singular, isolated skill-building exercises and instead prioritize the structural cultivation of collective identity. Community organizers should intentionally design spaces—both physical and digital—that foster deep emotional solidarity, shared narratives, and localized cultural cohesion, as these are the primary predictive drivers of sustained action. Furthermore, recognizing the non-linear threshold effect of social

networks, organizers should strategically focus on identifying and supporting naturally occurring network hubs—individuals who already possess moderate informational centrality—and empower them to bridge disconnected community clusters. Finally, because internal efficacy drives action far more robustly than external efficacy, empowerment programs must concentrate on bolstering women's internal cognitive resilience and practical self-advocacy skills, while simultaneously providing robust psychological support frameworks to mitigate the inevitable burnout associated with continuously fighting unresponsive external institutions.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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