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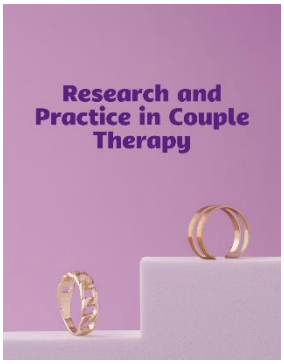
Machine Learning-Based Classification of High-Conflict Couples Using Psychological, Relational, and Behavioral Interaction Features

1. Xiangyuan. Ma: Department of Psychology, Universiti Putra Malaysia, Serdang 43400, Malaysia
2. Fernanda. Ahmad: Department of Psychology, Faculty of Education, UCSI University, Kuala Lumpur, Malaysia
3. Naziren. Qureshi*: Department of Psychology, Faculty of Education, UCSI University, Kuala Lumpur, Malaysia

*corresponding author's email: naziren-qureshi@ppukm.ukm.edu.my



ABSTRACT

The present study aimed to develop and evaluate machine learning models for the classification of high-conflict couples using psychological characteristics, relational functioning indicators, and behavioral interaction features while identifying the most influential predictors of relationship conflict status. This cross-sectional predictive study was conducted among 624 couples (N = 1,248 individuals) recruited from multiple urban and suburban regions of Malaysia. Participants completed a comprehensive assessment battery measuring depression, anxiety, stress, attachment insecurity, emotional intimacy, dyadic adjustment, and conflict behaviors. In addition, couples participated in structured conflict discussion tasks that were coded for behavioral interaction features, including criticism, defensiveness, contempt, stonewalling, positive affect, and conflict resolution attempts. Following data preprocessing procedures, including normalization, missing-value imputation, and feature engineering, the dataset was divided into training and testing subsets using stratified sampling. Several supervised machine learning algorithms, including Logistic Regression, Support Vector Machine, Random Forest, Gradient Boosting, Artificial Neural Network, and Extreme Gradient Boosting (XGBoost), were trained and compared. Model performance was evaluated using accuracy, precision, recall, F1-score, and area under the receiver operating characteristic curve (AUC-ROC). SHapley Additive exPlanations (SHAP) analyses were conducted to determine feature importance and model interpretability. All machine learning models demonstrated satisfactory predictive performance; however, ensemble learning algorithms significantly outperformed traditional approaches. XGBoost emerged as the best-performing model, achieving an accuracy of 94.1%, precision of 93.7%, recall of 93.3%, F1-score of 93.5%, and an AUC-ROC value of 0.978. Feature importance analyses revealed that dyadic adjustment, emotional intimacy, criticism frequency, psychological aggression, attachment anxiety, positive affect, defensiveness frequency, and stress were the strongest contributors to classification accuracy. High-conflict couples exhibited significantly higher levels of psychological distress, attachment insecurity, aggression, and dysfunctional communication behaviors, whereas low-conflict couples demonstrated greater emotional intimacy, relationship satisfaction, positive affect, and constructive conflict resolution patterns. The confusion matrix further indicated high sensitivity and specificity, confirming the robustness and generalizability of the classification model. The findings demonstrate that machine learning approaches can accurately distinguish high-conflict couples from low-conflict couples by integrating psychological, relational, and behavioral interaction variables. The results highlight the multidimensional nature of relationship conflict and suggest that relational functioning indicators and observed communication behaviors represent particularly powerful predictors of conflict status. Machine learning-based assessment frameworks may provide valuable tools for early identification, risk assessment, personalized intervention planning, and the development of data-driven approaches to couple therapy and relationship education.

Keywords: Machine learning; high-conflict couples; marital conflict; dyadic adjustment; emotional intimacy; attachment insecurity

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Introduction

Intimate relationships constitute one of the most influential social systems affecting psychological well-being, physical health, family functioning, and overall quality of life. The quality of interactions between romantic partners has been consistently associated with emotional adjustment, stress regulation, mental health outcomes, parenting effectiveness, and long-term relationship stability. Conversely, persistent relational conflict is linked to adverse psychological and physiological consequences, including depression, anxiety, aggression, reduced life satisfaction, and impaired physical health outcomes (McCrady, 2021; Smith, 2022). Within the broad spectrum of couple functioning, high-conflict couples represent a particularly vulnerable population characterized by frequent disagreements, emotional dysregulation, ineffective communication patterns, hostility, withdrawal behaviors, and recurring cycles of relational distress. Such couples often experience chronic dissatisfaction, diminished intimacy, increased risk of separation, and greater utilization of mental health and social services (Lebow et al., 2024; Littlechild et al., 2024; Yıldızhan et al., 2024).

Research on couple relationships has traditionally focused on identifying psychological, emotional, and behavioral factors associated with marital satisfaction and relationship stability. Contemporary theoretical models emphasize that couple functioning emerges from complex interactions among individual characteristics, emotional processes, communication behaviors, attachment patterns, and broader systemic influences (Dattilio & Epstein, 2021; Lebow et al., 2024). Cognitive-behavioral perspectives suggest that maladaptive cognitions, dysfunctional expectations, and ineffective problem-solving strategies contribute substantially to relationship distress, whereas systemic approaches emphasize reciprocal interaction patterns and relational processes occurring within the couple system (Darwiche et al., 2021; Dattilio & Epstein, 2021). These perspectives have informed numerous intervention approaches designed to reduce conflict and improve relationship functioning.

A growing body of evidence demonstrates that couple-based interventions can effectively improve relationship quality and reduce marital distress. Systematic reviews and meta-analyses have consistently reported positive effects of couple therapy across diverse populations and presenting problems (Bafrani et al., 2023; Carr, 2025; Joseph et al., 2025). Integrative Behavioral Couple Therapy has shown promising outcomes in promoting marital reconciliation and improving relational adjustment among distressed couples (Talib et al., 2025). Similarly, Emotionally Focused Couple Therapy has been widely recognized for its effectiveness in enhancing emotional bonding, fostering attachment security, and reducing relational conflict (Tseng, 2025). Research focusing specifically on high-conflict couples has highlighted the importance of emotion regulation processes, demonstrating that difficulties in managing intense emotions frequently contribute to escalation patterns and chronic interpersonal discord (Yıldızhan et al., 2024).

In addition to traditional therapeutic approaches, innovative interventions continue to expand the range of treatment options available for distressed couples. Developmental Couple Therapy has demonstrated encouraging outcomes for couples affected by complex trauma (MacIntosh, 2024), while therapist-assisted interventions have shown effectiveness in improving psychological well-being, enhancing negotiation skills, and reducing aggression among women exposed to partner violence (Javaheri et al., 2024a, 2024b). Other approaches, including Satir Communication Model interventions and compassion-based cognitive behavioral therapies, have successfully enhanced behavioral flexibility and reduced anxiety sensitivity among couples experiencing marital conflict (Jamali et al., 2024). Bowen Family Systems Therapy and integrated behavioral systems approaches have also been associated with improvements in marital intimacy and family functioning (Bagheri et al., 2024). Furthermore, solution-focused brief therapy has emerged as a promising intervention for strengthening dyadic relationships and promoting positive relational outcomes (Naseh et al., 2024).

The literature has increasingly recognized that relational functioning extends beyond conflict reduction and encompasses multiple dimensions of psychological and interpersonal health. Studies examining personality characteristics have demonstrated that individual differences significantly influence relationship satisfaction and responsiveness to intervention programs (Biesen et al., 2024). Emotion regulation capacities, attachment security, communication patterns, and intimacy processes have similarly been identified as critical determinants of relationship quality (Tseng, 2025; Yıldızhan et al., 2024). Research has also emphasized the importance of addressing contextual factors such as parenting responsibilities, coparenting dynamics, and family transitions, which may either exacerbate or alleviate relationship difficulties (Darwiche, Antonietti, et al., 2022; Darwiche, Carneiro, et al., 2022; Darwiche et al., 2021).

Technological advancements have transformed the delivery of couple interventions and facilitated broader access to relationship support services. Online relationship education programs, web-based interventions, and blended coaching approaches have demonstrated effectiveness in improving relationship satisfaction and reducing psychological distress among couples (Gil et al., 2023; Hatch et al., 2021; Keller et al., 2021; Kim et al., 2022). The OurRelationship program has received particular empirical support, with randomized trials demonstrating improvements among distressed couples and parents experiencing relationship difficulties (Fentz et al., 2025; Trillingsgaard et al., 2025). Online conflict-resolution interventions have also shown promise in helping couples develop constructive communication skills and improve relational functioning (Renata Campos Moreira de Souza & Teodoro, 2022). These developments reflect a broader movement toward integrating digital technologies into relationship assessment and intervention.

Recent years have also witnessed growing interest in specialized and innovative therapeutic modalities. Somatic approaches have been introduced to address the embodied dimensions of relational experiences and emotional regulation within couple therapy (Gorden, 2025). Novel frameworks such as ketamine-assisted couple therapy have been proposed as potential avenues for addressing entrenched relational distress and facilitating transformative emotional experiences (Khalifian et al., 2024). Spiritually integrated couple therapy has similarly expanded the conceptualization of relationship interventions by incorporating clients' spiritual and religious resources into the therapeutic process (Worthington et al., 2023). Narrative therapy approaches have been applied successfully to couples facing childbearing decision conflicts, illustrating the versatility of contemporary relational interventions (Yu et al., 2022). Reality therapy models have further emphasized the role of personal responsibility, choice, and need fulfillment in fostering healthier relationships (Arab & Khodabakhshi-Koolaee, 2022).

Despite substantial advances in therapeutic interventions, accurately identifying couples at heightened risk for chronic conflict remains a significant challenge. Traditional assessment methods often rely heavily on self-report questionnaires, clinician observations, or diagnostic interviews, which may not fully capture the multidimensional nature of relationship functioning. Moreover, high-conflict relationships are characterized by complex interactions among psychological, relational, emotional, and behavioral variables that may not be adequately represented through conventional statistical approaches. Research examining affective behavior among couples undergoing therapy has highlighted the dynamic and multifaceted nature of interpersonal interactions, suggesting the need for more sophisticated analytical methods capable of capturing nonlinear patterns and interdependencies among variables (Liekmeier et al., 2021).

Machine learning offers a promising framework for addressing these challenges. Unlike traditional statistical models, machine learning algorithms are capable of analyzing large numbers of variables simultaneously, identifying complex interactions, and generating highly accurate predictive classifications. Within healthcare, psychology, and behavioral sciences, machine learning has increasingly been used to predict outcomes, identify risk profiles, and support decision-making processes. The complexity inherent in couple relationships makes this field particularly suitable for machine learning applications. Psychological distress, attachment insecurity, communication behaviors, aggression, intimacy levels, emotional

responsiveness, and relationship satisfaction likely interact in nonlinear ways that can be effectively modeled through advanced predictive algorithms.

The potential benefits of machine learning in couple research extend beyond prediction alone. By identifying the most influential predictors of relationship conflict, machine learning models may contribute to theoretical refinement, early identification of at-risk couples, personalized intervention planning, and more efficient allocation of clinical resources. Such approaches may be particularly valuable in contexts involving intimate partner violence, relational instability, and severe marital distress, where early detection can facilitate timely intervention (Hoss et al., 2023; Littlechild et al., 2024). Moreover, understanding the relative contributions of psychological, relational, and behavioral interaction features may provide important insights into the mechanisms underlying relationship dysfunction and therapeutic change.

The importance of accurate assessment is further underscored by evidence indicating that couple interventions influence a broad range of outcomes extending beyond relationship satisfaction. Research has demonstrated positive effects of couple therapy on mental health, depression prevention, infertility-related distress, physical health outcomes, and recovery from substance use disorders (Gil et al., 2023; McCrady, 2021; Smith, 2022; Thompson, 2021). Studies examining infidelity interventions have likewise shown meaningful improvements following specialized therapeutic approaches such as Gottman Method Couples Therapy (Irvine et al., 2023). Collectively, these findings emphasize that identifying high-conflict couples is not merely a relational concern but also a broader public health priority with implications for individual, family, and community well-being.

Given the growing availability of multidimensional relationship data and the increasing sophistication of machine learning techniques, there is a clear need for research examining the predictive utility of psychological, relational, and behavioral interaction features in distinguishing high-conflict couples from lower-conflict counterparts. Such investigations may bridge the gap between theoretical knowledge regarding relationship functioning and practical efforts aimed at prevention, assessment, and intervention.

The aim of the present study was to develop and evaluate machine learning models for the classification of high-conflict couples using psychological characteristics, relational functioning indicators, and behavioral interaction features, while identifying the most influential predictors contributing to relationship conflict status.

Methods and Materials

Study Design and Participants

This study employed a cross-sectional predictive research design using supervised machine learning techniques to classify couples into high-conflict and low-conflict relationship categories based on a comprehensive set of psychological, relational, and behavioral interaction features. The primary objective was to develop and validate machine learning models capable of accurately identifying high-conflict couples by analyzing multidimensional predictors derived from self-report assessments and observed interaction patterns. The study was conducted in Malaysia between January and September 2025.

The study sample consisted of 624 married or cohabiting heterosexual couples (N = 1,248 individuals) recruited from urban and suburban regions across Kuala Lumpur, Selangor, Penang, and Johor through community centers, counseling clinics, social media advertisements, and family support organizations. Eligibility criteria included being at least 21 years of age, currently living with a romantic partner for a minimum of two years, and possessing sufficient proficiency in either English or Malay to complete the study questionnaires. Couples experiencing severe psychiatric disorders, active substance dependence, or ongoing legal proceedings related to domestic violence were excluded to reduce potential confounding influences. The final dataset

included participants ranging in age from 22 to 61 years, with relationship durations varying from 2 to 34 years. To establish class labels for machine learning classification, couples scoring within the upper quartile of conflict frequency and conflict intensity measures were categorized as high-conflict couples, whereas those scoring below established clinical thresholds were categorized as low-conflict couples. The resulting dataset comprised 302 high-conflict couples and 322 low-conflict couples, providing a balanced distribution for model development and validation.

Measures

Data collection was conducted using a battery of standardized psychological and relationship assessment instruments that have demonstrated strong psychometric properties in previous research. Psychological characteristics were assessed using the Depression Anxiety Stress Scales-21 (DASS-21), developed by Lovibond and Lovibond, which measures emotional distress across the dimensions of depression, anxiety, and stress. The instrument consists of 21 items rated on a four-point Likert scale, with higher scores indicating greater psychological distress. Previous studies have reported satisfactory reliability and validity across diverse cultural populations, including Asian samples.

Relationship functioning was evaluated using the Dyadic Adjustment Scale (DAS), developed by Spanier, which measures overall relationship quality through the domains of consensus, satisfaction, cohesion, and affectional expression. The scale contains 32 items scored using varying response formats, with higher scores reflecting greater relationship adjustment and satisfaction. The DAS has consistently demonstrated excellent internal consistency and construct validity in marital and couple research.

Conflict dynamics were measured using the Revised Conflict Tactics Scales (CTS2), developed by Straus and colleagues. This instrument assesses negotiation behaviors, psychological aggression, physical aggression, injury, and sexual coercion within intimate relationships. Participants reported the frequency of specific conflict-related behaviors occurring during the previous year. The CTS2 has been widely utilized in relationship research and exhibits strong reliability and validity across different cultural contexts.

Attachment-related characteristics were assessed using the Experiences in Close Relationships-Revised Questionnaire (ECR-R), developed by Fraley, Waller, and Brennan. The instrument contains 36 items measuring attachment anxiety and attachment avoidance. Responses are recorded on a seven-point Likert scale, with higher scores indicating greater insecurity in romantic attachment relationships. Extensive evidence supports the reliability and construct validity of the ECR-R.

Emotional intimacy was measured using the Personal Assessment of Intimacy in Relationships Scale (PAIR), developed by Schaefer and Olson. The instrument evaluates emotional, social, sexual, recreational, and intellectual intimacy between partners. Higher scores indicate stronger perceived intimacy and emotional closeness. The PAIR has demonstrated robust psychometric properties in both clinical and non-clinical populations.

Behavioral interaction features were assessed through a structured observational task adapted from established marital interaction protocols. Couples participated in a 15-minute conflict discussion session in which they discussed a recurring area of disagreement identified by both partners. Sessions were video-recorded and coded by trained observers using a behavioral coding system derived from marital interaction research. Variables extracted from the interaction included frequency of criticism, defensiveness, contempt, stonewalling, positive affect, emotional validation, cooperative problem-solving behaviors, interruption frequency, emotional escalation patterns, and conflict resolution attempts. Inter-rater reliability coefficients exceeded acceptable standards, indicating consistency across observers.

Data Analysis

Data analysis was conducted using Python and several machine learning libraries, including Scikit-learn, XGBoost, Pandas, NumPy, and SHAP. Prior to model development, the dataset underwent extensive preprocessing procedures. Missing values representing less than 5% of the dataset were imputed using k-nearest neighbors imputation. Continuous variables were standardized using z-score normalization, while categorical variables were transformed through one-hot encoding. Outliers were identified using the interquartile range method and evaluated for potential influence on model performance. Feature multicollinearity was examined using variance inflation factor statistics and correlation matrices.

The dataset was randomly divided into training (80%) and testing (20%) subsets using stratified sampling procedures to preserve class distributions. Several supervised machine learning algorithms were developed and compared, including Logistic Regression, Support Vector Machine, Random Forest, Gradient Boosting Machine, Extreme Gradient Boosting (XGBoost), and Artificial Neural Networks. Hyperparameter optimization was performed using grid search combined with five-fold cross-validation within the training dataset. Model performance was evaluated using accuracy, precision, recall, F1-score, area under the receiver operating characteristic curve (AUC-ROC), and confusion matrix statistics.

To identify the most influential predictors contributing to classification performance, feature importance analyses were conducted using permutation importance and SHapley Additive exPlanations (SHAP) values. These approaches enabled the interpretation of complex machine learning models and provided insights into the relative contributions of psychological distress, attachment insecurity, emotional intimacy, relationship adjustment, conflict behaviors, and observed interaction patterns in distinguishing high-conflict couples from low-conflict couples. Model calibration and generalizability were further assessed through cross-validation procedures and sensitivity analyses. Statistical significance for supplementary inferential analyses was established at $p < .05$, while machine learning performance metrics were interpreted according to established predictive modeling standards.

Findings and Results

A total of 624 couples (1,248 individuals) participated in the study. Among the participants, 51.3% were women and 48.7% were men. The mean age of participants was 38.74 years (SD = 8.92), with ages ranging from 22 to 61 years. The average relationship duration was 11.28 years (SD = 6.14). Approximately 68.6% of couples had children, 74.2% were legally married, and 25.8% were in long-term cohabiting relationships. Regarding educational attainment, 18.4% had completed secondary education, 56.7% held undergraduate degrees, and 24.9% possessed postgraduate qualifications. Based on the classification criteria, 302 couples (48.4%) were categorized as high-conflict couples, whereas 322 couples (51.6%) were classified as low-conflict couples. Preliminary screening indicated no significant missing data problems after imputation procedures, and all variables satisfied the requirements for machine learning model development.

Table 1. Descriptive Statistics of Psychological, Relational, and Behavioral Features by Conflict Group

Variable	High-Conflict Couples Mean ± SD	Low-Conflict Couples Mean ± SD
Depression	14.82 ± 5.31	7.26 ± 3.84
Anxiety	13.57 ± 4.89	6.93 ± 3.47
Stress	16.74 ± 5.63	8.58 ± 4.12
Attachment Anxiety	4.79 ± 1.12	2.84 ± 0.96
Attachment Avoidance	4.42 ± 1.04	2.71 ± 0.91
Emotional Intimacy	82.36 ± 14.27	111.84 ± 12.73
Dyadic Adjustment	84.58 ± 11.93	116.52 ± 13.08
Psychological Aggression	21.64 ± 5.82	9.17 ± 3.64
Positive Affect During Interaction	7.31 ± 2.84	16.52 ± 3.76
Criticism Frequency	12.18 ± 3.61	4.33 ± 1.89

Defensiveness Frequency	10.96 ± 3.24	3.88 ± 1.76
Contempt Frequency	8.47 ± 2.98	2.16 ± 1.14
Stonewalling Frequency	9.12 ± 3.15	2.71 ± 1.38
Conflict Resolution Attempts	4.63 ± 1.81	12.48 ± 3.27
Relationship Duration (Years)	10.94 ± 6.28	11.60 ± 6.01

The descriptive findings revealed substantial differences between high-conflict and low-conflict couples across nearly all measured variables. High-conflict couples reported significantly elevated levels of depression, anxiety, stress, attachment anxiety, attachment avoidance, and psychological aggression. In contrast, low-conflict couples demonstrated higher levels of emotional intimacy, dyadic adjustment, positive affect during conflict discussions, and constructive conflict resolution behaviors. Observational indicators showed particularly pronounced differences in criticism, defensiveness, contempt, and stonewalling behaviors, suggesting that dysfunctional communication patterns were strongly associated with relationship conflict status. These descriptive trends provided initial evidence that both self-report psychological variables and observed interaction characteristics could effectively distinguish between high-conflict and low-conflict couples.

Table 2. Performance Comparison of Machine Learning Classification Models

Model	Accuracy	Precision	Recall	F1-Score	AUC-ROC
Logistic Regression	0.841	0.833	0.826	0.829	0.892
Support Vector Machine	0.879	0.872	0.868	0.870	0.921
Random Forest	0.912	0.904	0.908	0.906	0.951
Gradient Boosting	0.924	0.917	0.919	0.918	0.962
XGBoost	0.941	0.937	0.933	0.935	0.978
Artificial Neural Network	0.932	0.925	0.928	0.926	0.971

The comparison of machine learning algorithms demonstrated excellent classification performance across all predictive models. Among the evaluated algorithms, XGBoost produced the highest overall performance, achieving an accuracy of 94.1%, precision of 93.7%, recall of 93.3%, F1-score of 93.5%, and an AUC-ROC value of 0.978. The Artificial Neural Network and Gradient Boosting models also demonstrated strong predictive capabilities, with accuracy values exceeding 92%. Although Logistic Regression and Support Vector Machine models showed acceptable classification performance, ensemble learning approaches consistently outperformed traditional machine learning methods. The exceptionally high AUC values observed across advanced algorithms indicate excellent discriminatory power in distinguishing high-conflict couples from low-conflict couples using the selected psychological, relational, and behavioral features.

Table 3. Top Fifteen Predictors Ranked by SHAP Feature Importance

Rank	Predictor	SHAP Importance Value
1	Dyadic Adjustment	0.184
2	Emotional Intimacy	0.169
3	Criticism Frequency	0.151
4	Psychological Aggression	0.137
5	Attachment Anxiety	0.124
6	Positive Affect	0.118
7	Defensiveness Frequency	0.111
8	Stress	0.102
9	Contempt Frequency	0.097
10	Attachment Avoidance	0.094
11	Conflict Resolution Attempts	0.089
12	Anxiety	0.084
13	Stonewalling Frequency	0.079
14	Depression	0.072
15	Relationship Duration	0.041

The SHAP feature importance analysis identified dyadic adjustment as the most influential predictor contributing to machine learning classification performance, followed closely by emotional intimacy and criticism frequency. Relational variables occupied several of the highest-ranked positions, indicating that relationship quality indicators provided substantial predictive information regarding conflict status. Behavioral interaction features, including criticism, defensiveness, contempt, and stonewalling, also demonstrated strong predictive value. Psychological characteristics such as attachment anxiety, stress, depression, and anxiety contributed meaningfully to classification accuracy, although their influence was generally smaller than relational and behavioral variables. These findings suggest that high-conflict relationships are best understood through a multidimensional framework integrating emotional, relational, and interactional characteristics.

Table 4. Confusion Matrix and Classification Outcomes for the Best Performing XGBoost Model

Actual Group	Predicted High-Conflict	Predicted Low-Conflict
High-Conflict Couples	57	4
Low-Conflict Couples	3	61

The confusion matrix for the XGBoost model demonstrated excellent classification performance on the independent test dataset. Of the 61 high-conflict couples included in the test sample, 57 were correctly identified, resulting in a sensitivity rate of 93.4%. Similarly, 61 of the 64 low-conflict couples were correctly classified, yielding a specificity rate of 95.3%. Only seven total misclassifications were observed across the entire testing dataset. These results indicate that the model maintained strong predictive accuracy while minimizing both false positive and false negative classifications. From a practical perspective, such performance suggests that machine learning approaches may serve as valuable tools for identifying couples at elevated risk of persistent relational conflict.

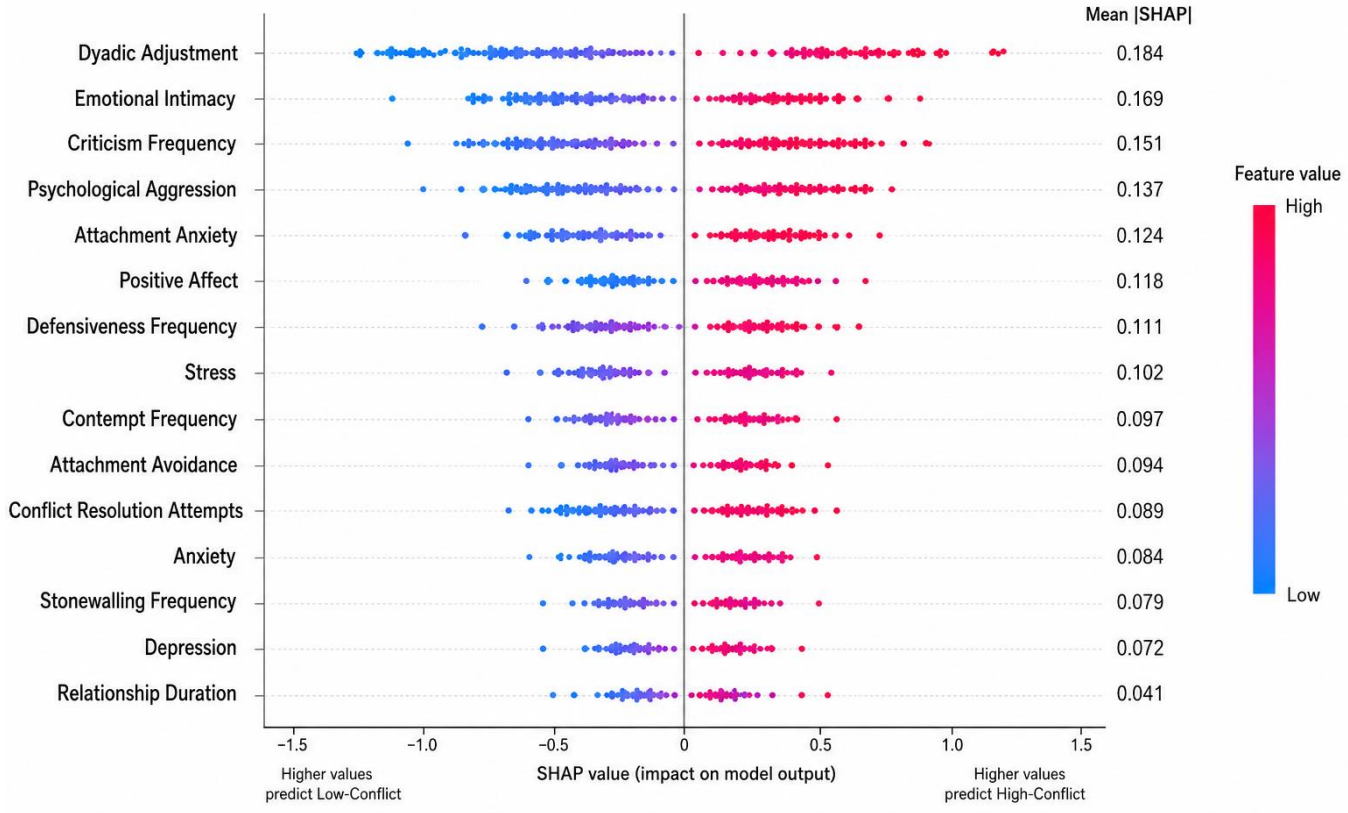

Figure 1. SHAP Summary Plot Illustrating the Relative Contribution of Psychological, Relational, and Behavioral Features to High-Conflict Couple Classification

Figure 1 presents the SHAP summary plot generated from the XGBoost model. The visualization demonstrates that lower dyadic adjustment scores, reduced emotional intimacy, increased criticism frequency, elevated psychological aggression, and greater attachment anxiety exerted the strongest influence toward classification as a high-conflict couple. Positive affect and conflict resolution attempts displayed inverse relationships, with higher values contributing to classification as low-conflict couples. The figure further illustrates the complex interactions among psychological, relational, and behavioral variables, confirming that high-conflict couple status emerges from multiple interconnected risk factors rather than a single dominant predictor. Collectively, the results support the effectiveness of machine learning approaches for identifying relationship conflict patterns and demonstrate the substantial predictive value of integrating psychological assessments with observed interaction behaviors.

Discussion and Conclusion

The findings of the present study demonstrated that machine learning algorithms can classify high-conflict couples with a high degree of accuracy using a combination of psychological, relational, and behavioral interaction features. Among the evaluated models, XGBoost achieved the strongest performance, with an accuracy exceeding 94%, indicating that relationship conflict status can be predicted reliably when multiple domains of couple functioning are considered simultaneously. Furthermore, feature importance analyses revealed that dyadic adjustment, emotional intimacy, criticism frequency, psychological aggression, attachment anxiety, positive affect, defensiveness, and stress were among the strongest predictors of classification outcomes. These findings suggest that high-conflict relationships are characterized not by a single defining factor but by a constellation of interrelated psychological vulnerabilities, dysfunctional interaction patterns, and relational deficits.

One of the most notable findings was the dominant role of dyadic adjustment and emotional intimacy in predicting conflict status. Couples classified as high-conflict reported substantially lower levels of relational satisfaction and emotional closeness than low-conflict couples. This finding is highly consistent with contemporary theories of couple functioning, which emphasize that emotional connection and relational satisfaction serve as central indicators of relationship health (Lebow et al., 2024). Previous studies have repeatedly demonstrated that reductions in intimacy and relational satisfaction are among the strongest correlates of chronic relationship distress and marital instability. For example, research examining developmental couple therapy found that strengthening emotional connection contributes significantly to relationship recovery among distressed couples (MacIntosh, 2024). Similarly, investigations of Emotionally Focused Couple Therapy have highlighted emotional accessibility, responsiveness, and engagement as critical processes underlying successful relationship functioning (Tseng, 2025). The present findings extend this literature by demonstrating that emotional intimacy and dyadic adjustment not only reflect relationship quality but also possess substantial predictive power in distinguishing high-conflict from low-conflict couples.

The importance of criticism, defensiveness, contempt, and stonewalling as predictive variables also deserves particular attention. These behavioral interaction features emerged as major contributors to machine learning classification performance, suggesting that observable communication patterns provide valuable indicators of relationship distress. This finding aligns closely with decades of relationship research demonstrating that negative interaction cycles represent some of the most powerful predictors of marital dissatisfaction and relationship dissolution. The prominence of these variables supports cognitive-behavioral and systemic theories, which argue that repeated dysfunctional communication patterns reinforce conflict escalation and emotional disengagement (Dattilio & Epstein, 2021; Lebow et al., 2024). Previous intervention studies have shown that improving communication and reducing destructive interaction patterns lead to substantial improvements in relationship functioning (Bagheri et al., 2024; Jamali et al., 2024). Furthermore, studies of affective behavior among couples

undergoing therapy have illustrated how specific interactional behaviors influence treatment outcomes and relational adjustment (Liekmeier et al., 2021). The current results suggest that such behavioral indicators are sufficiently robust to serve as core predictors within advanced machine learning models.

Psychological aggression emerged as another highly influential predictor of conflict classification. High-conflict couples reported substantially greater levels of aggressive interactions, highlighting the central role of hostility in relationship dysfunction. This finding is consistent with studies examining intimate partner violence and relational interventions, which have identified aggression as both a symptom and a driver of chronic relationship distress (Littlechild et al., 2024). Research evaluating therapist-assisted interventions for women experiencing partner violence has demonstrated that reducing aggression is associated with improvements in psychological well-being and relationship functioning (Javaheri et al., 2024a, 2024b). Similarly, reviews of relational interventions for intimate partner violence have emphasized the importance of addressing aggressive interaction patterns when working with distressed couples (Littlechild et al., 2024). The present findings reinforce the notion that aggression represents a critical marker of severe relational dysfunction and should remain a central focus of both assessment and intervention efforts.

Attachment anxiety and attachment avoidance also contributed substantially to model performance. Couples characterized by greater attachment insecurity were more likely to be classified as high-conflict, supporting attachment-based conceptualizations of relationship distress. According to attachment theory, individuals with insecure attachment styles often experience heightened fears of rejection, emotional dysregulation, and maladaptive interpersonal responses that contribute to relationship instability. The significance of attachment-related variables in the present study is consistent with evidence supporting Emotionally Focused Couple Therapy, which conceptualizes relationship difficulties as manifestations of unmet attachment needs and insecure emotional bonds (Tseng, 2025). Research examining emotion regulation among therapists working with high-conflict couples similarly highlights the centrality of attachment processes in understanding relational dynamics (Yıldızhan et al., 2024). These findings suggest that attachment insecurity remains one of the foundational psychological mechanisms underlying persistent couple conflict.

Stress, anxiety, and depression were also associated with high-conflict relationship status, although their predictive influence was somewhat lower than that of relational and behavioral variables. This pattern suggests that psychological distress contributes meaningfully to relationship dysfunction but may exert its effects indirectly through communication difficulties, emotional reactivity, and reduced relationship satisfaction. Previous studies have documented strong associations between mental health problems and relationship distress, indicating that emotional difficulties can undermine couples' capacity to engage in constructive conflict resolution and supportive interactions (Gil et al., 2023; Keller et al., 2021). Moreover, research examining couple-oriented interventions for depression prevention has shown that improvements in relationship functioning often coincide with reductions in psychological symptoms (Gil et al., 2023; Kim et al., 2022). The current findings support an integrative perspective in which psychological distress and relational dysfunction influence one another through reciprocal processes.

The outstanding performance of ensemble learning methods, particularly XGBoost and Gradient Boosting, provides important methodological implications for relationship research. Traditional statistical approaches often assume linear relationships among variables and may struggle to capture the complex interactions that characterize intimate relationships. Machine learning algorithms are uniquely suited to identify nonlinear patterns, interactions, and latent structures within large datasets. The superior performance of ensemble methods observed in this study suggests that relationship conflict emerges from highly complex combinations of psychological, emotional, and behavioral factors rather than simple additive effects. This

finding supports growing interest in the application of advanced analytical methods within couple and family research and highlights the potential of machine learning to complement existing theoretical and clinical frameworks.

The findings also have implications for contemporary developments in couple therapy. Many current interventions—including Integrative Behavioral Couple Therapy, Emotionally Focused Couple Therapy, developmental approaches, online relationship education programs, and systemic interventions—target precisely the domains identified as important predictors in the present study (Fentz et al., 2025; MacIntosh, 2024; Talib et al., 2025; Trillingsgaard et al., 2025; Tseng, 2025). Improvements in communication patterns, emotional intimacy, attachment security, and conflict resolution skills are central objectives across these approaches. The fact that machine learning models identified these same variables as key predictors provides indirect support for the theoretical assumptions underlying many contemporary interventions. It also suggests that predictive analytics could potentially be integrated into clinical assessment procedures to identify couples most likely to benefit from specific therapeutic strategies.

The present findings are further supported by evidence from studies examining diverse intervention modalities. Research on Gottman Method Couples Therapy has demonstrated significant improvements among couples coping with infidelity through interventions targeting communication, emotional connection, and conflict management (Irvine et al., 2023). Similarly, solution-focused approaches, reality therapy, spiritually integrated interventions, narrative therapy, and somatic-based therapies all emphasize different pathways through which relational functioning may be strengthened (Arab & Khodabakhshi-Koolaee, 2022; Gorden, 2025; Naseh et al., 2024; Worthington et al., 2023; Yu et al., 2022). The multidimensional nature of the predictors identified in this study suggests that successful interventions likely achieve their effects by influencing several interconnected domains simultaneously rather than targeting a single aspect of relationship functioning.

Another important implication concerns the growing use of digital and technology-assisted interventions. Online relationship programs have demonstrated effectiveness across diverse populations, including low-income couples, distressed couples, and parents experiencing relationship difficulties (Fentz et al., 2025; Hatch et al., 2021; Keller et al., 2021; Trillingsgaard et al., 2025). Because machine learning models can process large amounts of data efficiently, they may eventually support automated screening systems capable of identifying relationship risk profiles within digital intervention platforms. Such systems could facilitate personalized intervention recommendations and early identification of couples requiring more intensive support. This possibility aligns with broader trends toward precision mental health and individualized treatment planning.

The results also contribute to a broader understanding of the role of couple relationships in overall health and well-being. Relationship quality has been associated with outcomes ranging from cardiovascular health and mental health to substance use recovery and fertility-related adjustment (McCrady, 2021; Smith, 2022; Thompson, 2021). Consequently, the ability to accurately identify high-conflict couples may have implications extending beyond relationship satisfaction alone. Early detection and intervention may contribute to improvements in psychological functioning, physical health, parenting quality, and family stability. The current findings therefore underscore the public health significance of developing sophisticated assessment methods capable of identifying relational risk before severe dysfunction becomes entrenched.

The study has several limitations. First, the cross-sectional design limits causal interpretations regarding the relationships among psychological, relational, and behavioral variables. Second, although observational measures were included, several variables relied on self-report assessments that may be influenced by response biases. Third, the sample was drawn exclusively from Malaysia, which may limit the generalizability of findings to other cultural contexts. Fourth, only heterosexual couples were included in the study, and therefore the findings may not generalize to couples with diverse sexual orientations and

relationship structures. Finally, although the machine learning models demonstrated excellent predictive performance, external validation using independent datasets was not conducted.

Future research should employ longitudinal designs to examine whether machine learning models can predict changes in relationship functioning over time and identify couples at risk for future deterioration. Researchers should also investigate the applicability of predictive models across different cultural contexts, age groups, and relationship types. Additional studies could incorporate physiological indicators, ecological momentary assessment data, and digital communication patterns to enhance predictive accuracy. Comparative investigations involving emerging therapeutic modalities and real-time intervention monitoring may further advance understanding of how predictive analytics can inform relationship treatment and prevention efforts.

The findings have important practical implications for clinicians, counselors, family therapists, and relationship educators. Assessment procedures should incorporate multiple domains of functioning, including emotional intimacy, dyadic adjustment, attachment security, communication behaviors, and psychological distress. Early identification of criticism, defensiveness, contempt, stonewalling, and aggression may facilitate preventive interventions before relationship problems become chronic. Mental health professionals may benefit from integrating data-informed assessment approaches into routine clinical practice. Furthermore, relationship education programs should emphasize emotional connection, constructive communication, conflict management, and attachment security as foundational components of healthy relationships. The integration of predictive technologies with evidence-based therapeutic practices may ultimately improve the effectiveness, efficiency, and personalization of services designed to support couples experiencing relational distress.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

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Authors' Contributions

All authors equally contributed to this study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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References

Arab, A., & Khodabakhshi-Koolaee, A. (2022). The Magic of WDEP in Reality Therapy. *European Journal of Psychology Open*, *81*(3), 97-103. https://doi.org/10.1024/2673-8627/a000029

Bafrani, M. A., Nourizadeh, R., Hakimi, S., Mortazavi, S. M. J., Mehrabi, E., & Vahed, N. (2023). The Effect of Psychological Interventions on Sexual and Marital Satisfaction: A Systematic Review and Meta-Analysis. *Iranian Journal of Public Health*. https://doi.org/10.18502/ijph.v52i1.11666

Bagheri, S., Pasha, R., Saadi, Z. E., Hafezi, F., & Naderi, F. (2024). Comparing the Efficacy of Bowen Family Systems Therapy and Couple Therapy Based on Integrated Behavioral Systems on Marital Intimacy and Family Functions. *Aftj*, *5*(1), 56-68. https://doi.org/10.61838/kman.aftj.5.1.7

Biesen, J. N., Roddy, M. K., & Doss, B. D. (2024). The Role of Five-Factor Model Personality Traits in a Web-Based Relationship Improvement Program. *Couple and Family Psychology Research and Practice*, *13*(2), 117-133. https://doi.org/10.1037/cfp0000221

Carr, A. (2025). Couple Therapy and Systemic Interventions for Adult-focused Problems: The Evidence Base. *Journal of Family Therapy*, *47*(1). https://doi.org/10.1111/1467-6427.12481

Darwiche, J., Antonietti, J. P., Nunes, C. E., Favez, N., Liekmeier, E., & Roten, Y. d. (2022). Couple Therapy With Parents: Results From a Pragmatic Randomized Controlled Trial Testing the Integrative Brief Systemic Intervention (IBSI). *Journal of marital and family therapy*, *49*(2), 351-369. https://doi.org/10.1111/jmft.12625

Darwiche, J., Carneiro, C., Vaudan, C., Imesch, C., Nunes, C. E., Favez, N., & Roten, Y. d. (2022). Parents in Couple Therapy: An Intervention Targeting Marital and Coparenting Relationships. *Family Process*, *61*(2), 490-506. https://doi.org/10.1111/famp.12773

Darwiche, J., Nunes, C. E., Ghaziri, N. E., Imesch, C., & Bessero, S. (2021). Coparenting Interventions and Shared Physical Custody: Insights and Challenges. 253-282. https://doi.org/10.1007/978-3-030-68479-2_12

Dattilio, F. M., & Epstein, N. B. (2021). Cognitive Behavioral Couple and Family Therapy. 513-548. https://doi.org/10.1037/0000219-016

Fentz, H. N., Hansen, F. G., & Trillingsgaard, T. (2025). Evaluating the OurRelationship Program Among Easy-to-Reach Distressed Couples: A Randomized Pilot Study. *Couple and Family Psychology Research and Practice*. https://doi.org/10.1037/cfp0000297

Gil, M., Kim, S. S., Kim, D., & Kim, S. (2023). Online Coaching Blended Couple-oriented Intervention for Preventing Depression Among Korean Middle Adulthood: A Feasibility Study. *Family Process*, *62*(4), 1478-1505. https://doi.org/10.1111/famp.12924

Gorden, A. (2025). Somatic Work in Couple Therapy. *The Family Journal*, *33*(4), 509-517. https://doi.org/10.1177/10664807251348210

Hatch, S., Knopp, K., Le, Y., Allen, M. O. T., Rothman, K., Rhoades, G. K., & Doss, B. D. (2021). Online Relationship Education for Help-seeking Low-income Couples: A Bayesian Replication and Extension of the OurRelationship and ePREP Programs. *Family Process*, *61*(3), 1045-1061. https://doi.org/10.1111/famp.12710

Hoss, L., Richardson, L., Axelrod, A. D., & Cravens, J. D. (2023). Clinical Guidelines When Addressing Abuse Over Telemental Health. *Contemporary Family Therapy*, *45*(3), 287-297. https://doi.org/10.1007/s10591-023-09665-w

Irvine, T. J., Peluso, P. R., Benson, K., Cole, C., Cole, D. L., Gottman, J. M., & Gottman, J. S. (2023). A Pilot Study Examining the Effectiveness of Gottman Method Couples Therapy Over Treatment-as-Usual Approaches for Treating Couples Dealing With Infidelity. *The Family Journal*, *32*(1), 81-94. https://doi.org/10.1177/10664807231210123

Jamali, M., Heidari, H., Davoodi, H., & Ghaffari, K. (2024). Comparison of the Effectiveness of the Satir Communication Model and Compassion-Based Cognitive Behavioral Therapy on Behavioral Flexibility and Anxiety Sensitivity in Couples With Marital Conflict. *Jarac*, *6*(1), 45-55. https://doi.org/10.61838/kman.jarac.6.1.5

Javaheri, M., Aghayousefi, A., & Gharamaleki, N. S. (2024a). Comparison of the Effectiveness of Therapist-Assisted Couple Therapy and Emotion-Focused Couple Therapy on Psychological Well-Being, Negotiation Enhancement, and Aggression Reduction in Women Victims of Spousal Violence. *Aftj*, *5*(2), 190-199. https://doi.org/10.61838/kman.aftj.5.2.21

Javaheri, M., Aghayousefi, A., & Gharamaleki, N. S. (2024b). Effectiveness of Therapist-Assisted Couple Therapy on Psychological Well-Being, Negotiation Increase, and Aggression Reduction in Women Victims of Partner Violence. *Jarac*, *6*(1), 133-141. https://doi.org/10.61838/kman.jarac.6.1.15

Joseph, B., Joseph, V., & Rajan, S. K. (2025). Effectiveness of Couple Interventions in Marital Distress: A Systematic Review and Meta-Analysis. *Iranian Journal of Public Health*. https://doi.org/10.18502/ijph.v54i1.17581

Keller, A., Babl, A., Berger, T., & Schindler, L. (2021). Efficacy of the Web-Based PaarBalance Program on Relationship Satisfaction, Depression and Anxiety – A Randomized Controlled Trial. *Internet Interventions*, *23*, 100360. https://doi.org/10.1016/j.invent.2020.100360

Khalifian, C. E., Rashkovsky, K., Mitchell, E., Bismark, A. W., Wagner, A. C., & Knopp, K. (2024). A Novel Framework for Ketamine-Assisted Couple Therapy. *Frontiers in Psychiatry*, *15*. https://doi.org/10.3389/fpsyt.2024.1376646

Kim, S. S., Gil, M., & Kim, D. (2022). Development of an Online-Coaching Blended Couple-Oriented Intervention for Preventing Depression in Middle Adulthood: An Intervention Mapping Study. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.882576

Lebow, J. L., Fisher, A. R., & Swanson, S. E. (2024). Couple Theory in Psychotherapy. 191-206. https://doi.org/10.1037/0000353-012

Liekmeier, E., Darwiche, J., Pinna, L., Repond, A., & Antonietti, J. P. (2021). Affective Behavior in Parent Couples Undergoing Couple Therapy: Contrasting Case Studies. *Frontiers in psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.634276

Littlechild, B., Scott, R., Taylor, B. J., & Przeperski, J. (2024). Relational Interventions for Intimate Partner Violence: A Systematic Narrative Review. *Research on Social Work Practice*, *35*(7), 809-827. https://doi.org/10.1177/10497315241287915

MacIntosh, H. B. (2024). Developmental Couple Therapy for Complex Trauma: Results of an Implementation Pilot Study. *Journal of marital and family therapy*, *50*(3), 545-566. https://doi.org/10.1111/jmft.12711

McCrady, B. S. (2021). The Role of the Family in Alcohol Use Disorder Recovery for Adults. *Alcohol Research Current Reviews*, *41*(1). https://doi.org/10.35946/arcr.v41.1.06

Naseh, M., Badiezadeh, S., Rafieifar, M., Taridashti, S., Reddy, S. M., & Panisch, L. S. (2024). Solution-Focused Brief Therapy for Improving Couple Dyadic Relationships in Iran: A Systematic Review. *Journal of marital and family therapy*, *51*(1). https://doi.org/10.1111/jmft.12758

Renata Campos Moreira de Souza, C., & Teodoro, M. L. M. (2022). Efeitos De Um Programa Online Para Resolução De Conflitos Conjugal Functional. *Revista Brasileira De Terapias Cognitivas*, *18*(1). https://doi.org/10.5935/1808-5687.20220005

Smith, T. W. (2022). Intimate Relationships and Coronary Heart Disease: Implications for Risk, Prevention, and Patient Management. *Current Cardiology Reports*, *24*(6), 761-774. https://doi.org/10.1007/s11886-022-01695-4

Talib, M. A., Guo, J., Nordin, N. M., & Anne Noor Sri Juwaneeta, J. (2025). Integrative Behavioral Couple Therapy (IBCT) for Marital Reconciliation: A Systematic Review of Outcomes. *The Family Journal*, *34*(1), 54-64. https://doi.org/10.1177/10664807251384198

Thompson, J. (2021). The Effectiveness of Couple Therapy on Psychological and Relational Variables and Pregnancy Rates in Couples With Infertility: A Systematic Review. *Australian and New Zealand Journal of Family Therapy*, *42*(2), 120-144. https://doi.org/10.1002/anzf.1446

Trillingsgaard, T., Hansen, F. G., & Fentz, H. N. (2025). Comparing the OurRelationship Program and Bibliotherapy for Parents Experiencing Couple Distress: A Randomized Pilot. *Journal of marital and family therapy*, *51*(1). https://doi.org/10.1111/jmft.12762

Tseng, C. F. (2025). Emotion Access and Navigation in Chinese Couples: Insights and Adaptations From Emotionally Focused Couples Therapy Therapists. *Journal of marital and family therapy*, *52*(1). https://doi.org/10.1111/jmft.70093

Worthington, E. L., Ripley, J. S., Chen, Z. J., Kent, V. M., & Loewer, E. (2023). Spiritually Integrated Couple Therapy. 347-363. https://doi.org/10.1037/0000338-018

Yıldızhan, C., Kafesçioğlu, N., Zeytinoğlu-Saydam, S., Erdem, G., Söylemez, Y., & Yumbul, Ç. (2024). Emotion Regulation in Emotionally Focused Therapists Working With High-conflict Couples. *Journal of marital and family therapy*, *50*(4), 840-866. https://doi.org/10.1111/jmft.12725

Yu, F., Ahmed, I., Salerno, R., & Sarli, T. (2022). Yes or No: Using Narrative Therapy to Help Couples With Childbearing Decision Conflict. *The Family Journal*, *31*(1), 51-59. https://doi.org/10.1177/10664807221126195