



Article Type: Original Research

Article history:

Received 13 June 2025

Revised 19 August 2025

Accepted 22 August 2025

Published online 01 September 2025

NLP-Driven Identification of Communication Deficits Predicting Therapy Dropout in Couples

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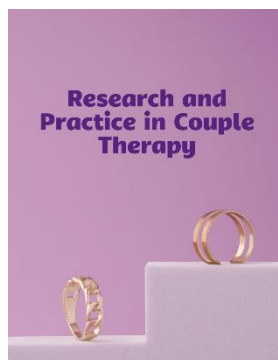
ABSTRACT

This study aimed to determine whether natural language patterns extracted from early couple therapy sessions can accurately predict premature therapy dropout. The study used a mixed quantitative–qualitative design involving 148 couples from Canada who participated in community, private, and university-based couple therapy settings. High-quality audio recordings of the first two therapy sessions were transcribed and preprocessed using advanced natural language processing techniques, including tokenization, lemmatization, turn-level segmentation, and affective, syntactic, and semantic feature extraction via transformer-based models. Communication variables such as emotional disengagement, interruption frequency, partner-focused pronoun use, and demand–withdraw sequences were quantified. Machine-learning models—logistic regression, random forest, gradient boosting, Bi-LSTM networks, and transformer architectures—were trained to predict dropout, defined as termination prior to session four without therapist-approved discontinuation. Model performance metrics included accuracy, precision, recall, F1 score, and ROC-AUC. SHAP values were used to interpret model-level decision patterns. Reflexive thematic analysis of therapist notes complemented quantitative findings to contextualize communication deficits. Inferential analyses revealed significant differences between dropout and treatment-completion groups across multiple linguistic variables, including higher negative affect, lower partner-focused pronouns, greater interruption frequency, and elevated demand–withdraw cycles among dropout couples (all $p < .001$). Transformer-based models achieved the strongest predictive accuracy (92%) and highest ROC-AUC (0.96), outperforming all traditional and neural baselines. SHAP interpretability demonstrated that emotional disengagement markers, interruption frequency, topic abruptness, and conversational asymmetry were the most influential predictors of dropout. Communication reciprocity declined over time in dropout couples, whereas it increased in treatment completers. Early-session communication deficits captured through natural language processing serve as powerful predictors of premature dropout in couple therapy. Incorporating automated linguistic assessment tools into routine clinical practice may enable earlier identification of at-risk couples and support targeted intervention strategies to reduce attrition.

Keywords: couple therapy; dropout prediction; NLP; communication deficits; emotional disengagement; machine learning; early intervention; relationship processes

How to cite this article:

Navabinejad, Sh., Rostami, M., & Parsakia, P. (2025). NLP-Driven Identification of Communication Deficits Predicting Therapy Dropout in Couples. *Research and Practice in Couple Therapy*, 3(3), 1-13. <https://doi.org/10.61838/rpct.3.3.3>



Introduction

Premature dropout from couple therapy presents one of the most persistent and costly challenges for clinicians, researchers, and healthcare systems worldwide (Sippel et al., 2023). Despite decades of development in relational interventions, a substantial proportion of couples discontinue treatment before achieving meaningful therapeutic gains, often withdrawing within the first few sessions. Recent evidence has demonstrated that dropout is not merely a random event but is linked to identifiable



interpersonal, emotional, and structural processes emerging early in treatment. Understanding these processes has become an urgent priority given that early termination significantly reduces the likelihood of long-term relational stability, increases psychological distress, and strains clinical resources. Existing research on predictors of attrition in couple and family therapy has uncovered various client-level, relational, and contextual determinants (Carone et al., 2025), yet the field still lacks systematic investigations into communication-based precursors of dropout—particularly those encoded in natural language and observable during the initial therapeutic encounters.

Dropout in relational interventions is a significant issue across specialized clinical populations as well. For instance, work in the context of HIV care demonstrates that couple-based engagement strategies can influence retention and program adherence, highlighting the broader relevance of relational dynamics in maintaining treatment continuity (Belus et al., 2025). Studies addressing microaggressions in therapeutic relationships also reveal that subtle forms of interpersonal invalidation can mediate early withdrawal, especially among sexual minority couples, underlining the complex and often hidden nature of communication-related dropout triggers (Carone et al., 2025). These findings suggest that small-scale relational ruptures—often invisible to therapists—carry consequences for treatment stability and underscore the need for more sensitive tools capable of capturing early relational deterioration.

Across diverse therapeutic contexts, concerns about dropouts appear as recurring themes. For example, work examining why couples fail to return for infertility treatment after initial consultations highlights emotional strain, mismatched expectations, and communication breakdowns as major barriers to treatment continuation (Scognamiglio et al., 2025). Complementary findings in infertility care further demonstrate that medical stressors interact with relational dynamics, shaping the couple's willingness to sustain treatment efforts (Stein et al., 2023). Research on the psychological burden associated with fertility interventions during the COVID-19 pandemic similarly indicates that emotional distress alters decision-making and disrupts help-seeking behaviors, further illustrating the importance of communication and emotional support for treatment adherence (Buzzaccarini et al., 2023). Collectively, these studies point to a widespread pattern: interpersonal stressors and communication difficulties function as central barriers to treatment engagement, regardless of clinical domain.

Communication itself represents one of the most powerful determinants of relational functioning and therapeutic progress. Evidence from structured couple therapy programs shows that interventions directly targeting communication skills can significantly improve conflict resolution and relational sensitivity (Jalili et al., 2024). Parallel experimental work demonstrates that paradoxical approaches emphasizing reframing and self-differentiation also enhance marital intimacy by helping partners clarify their emotional positions and reduce maladaptive expressive patterns (Joudari & Anasseri, 2024). Moreover, research on couple-based interventions in different cultural contexts suggests that communication patterns intersect with other systemic factors, including power dynamics, socio-political stressors, and competing identity roles. For example, studies addressing the role of child protection officers in Arab communities reveal how communication, authority, and emotional expression are shaped by structural factors such as state oversight and cultural expectations (Alhuzail & Jedwab, 2024). These findings highlight the interconnectedness of communication, relational experiences, and systemic pressures, reinforcing the idea that communication deficits are not only interpersonal but are shaped by contextual conditions.

Complementary research from outside the couple therapy domain further expands our understanding of communication as an essential component of treatment engagement. In work focusing on cognitive stimulation therapy for individuals with intellectual disability and dementia, communication scaffolding has been identified as a critical factor influencing treatment feasibility and participant retention (Ali et al., 2025). Similarly, studies exploring remote physical activity interventions with individuals suffering from depression and anxiety indicate that motivational messaging—essentially a structured form of communication—plays a significant role in adherence rates, supporting the centrality of communication processes in sustaining

engagement (Caudroit et al., 2024). Remote health monitoring research reinforces this view: the effectiveness of digital follow-up systems depends heavily on timely, accurate, and relationally sensitive communication exchanges between systems and users (Cay et al., 2024). These insights from broader psychosocial and technological intervention literature demonstrate that communication failures, whether human or system-mediated, consistently undermine engagement across diverse health contexts.

Furthermore, there is growing recognition that emotional vulnerability, social stress, and cognitive overload may alter communication patterns in ways that predict withdrawal from therapeutic or supportive interventions. Evidence from telerehabilitation research illustrates that emotional strain and perceived disconnect can reduce participation, emphasizing the role of communication style and emotional expression in sustaining therapeutic engagement (Park et al., 2023). Parallel findings in post-trauma couple therapy confirm that relationship satisfaction and communication quality predict treatment outcomes, suggesting their potential utility in anticipating treatment instability (Sippel et al., 2023). Across various clinical populations, communication patterns reliably forecast whether individuals maintain or discontinue therapeutic contact.

In recent years, methodological advances have opened new possibilities for detecting subtle communication deficits. Developments in computational techniques, particularly natural language processing (NLP), enable researchers to extract semantic, syntactic, and affective markers from large volumes of conversational data at a level of detail unattainable through manual observation. Outside psychology, technological innovations in digital encoding, error correction, and semantic representation illustrate the power of computational systems in capturing complex patterns with precision. For example, recent work in DNA storage technology demonstrates advanced methods for encoding, decoding, and identifying intricate patterns in data streams (Welzel et al., 2023). In forensic science, advancements in sequencing technologies similarly show the capacity of automated systems to detect fine-grained features with high accuracy, underscoring the reliability and sophistication of contemporary computational approaches (McNevin et al., 2024). These innovations collectively support the premise that computational extraction of subtle patterns—in this case, linguistic markers of communication deficits—can provide robust insights relevant to therapy dropout prediction.

The move toward technology-enhanced psychological assessment is further supported by work in clinical trial methodology and behavioral intervention research. Studies leveraging system-based frameworks for psychotherapy readiness highlight the necessity of systematically identifying behavioral markers that precede therapeutic engagement outcomes (Hovmand et al., 2023). Similarly, research on employment and functional recovery among individuals with early psychosis demonstrates how structured assessments and individualized support systems improve long-term engagement (Jäckel et al., 2025). The emphasis in these studies on predictive markers, early detection, and tailored intervention aligns directly with the goals of integrating NLP-based approaches into couple therapy research.

Despite these advances, the application of NLP to couple communication remains underdeveloped. Research has not yet fully integrated computational linguistic analysis with relational therapy outcomes, even though couple interactions—especially during initial sessions—are rich with verbal and paraverbal information that may reveal relational distress, asymmetry, or disengagement. Communication deficits such as interruption frequency, emotional withdrawal, pronoun usage patterns, and low reciprocity often manifest early and intensify over time, yet therapists cannot always detect them in real time due to cognitive overload, session complexity, or subtle expression. Given that early dropout often occurs before therapists can intervene effectively, automated tools capable of identifying at-risk couples based on their early communication patterns may substantially improve clinical decision-making and reduce attrition rates.

The COVID-19 pandemic has further highlighted the need for innovative methods to monitor communication and engagement. Research on delayed fertility treatments during the pandemic demonstrates how stress and uncertainty alter

couples' decision-making processes and perceptions of relational support (Buzzaccarini et al., 2023). Similarly, work on remote interventions during periods of restricted physical contact underscores the importance of analyzing communication signals that may not be explicitly expressed during sessions but still contribute to perceived alliance and commitment (Caudroit et al., 2024). These findings support the broader argument that communication stability—and its early measurement—plays a decisive role in whether couples remain in treatment.

The use of NLP-based predictors of dropout is therefore timely, methodologically justified, and clinically relevant. By combining machine learning with established relational theory, researchers now have the capacity to examine the linguistic micro-patterns embedded in couples' speech that may indicate disengagement long before dropout occurs. Given the known consequences of early termination, identifying these markers is not merely an academic goal but a clinical imperative with implications for therapist training, treatment planning, and intervention tailoring.

The aim of this study is to examine natural language-based communication deficits in early couple therapy sessions and determine their predictive value for identifying couples at risk of premature therapy dropout.

Methods and Materials

Study Design and Participants

The study adopted a quantitative–qualitative hybrid design aimed at uncovering linguistic and communication-related indicators that may predict premature dropout from couple therapy. The research relied on a naturalistic sample of couples who initiated therapy with licensed couple and family therapists across three Canadian provinces, including British Columbia, Ontario, and Alberta. Participants were recruited from community counselling centres, private practices, and university-affiliated training clinics. Eligibility criteria required couples to be at least 18 years old, cohabiting or married for a minimum of one year, and entering therapy to address relational distress. Couples who lacked fluency in English, who were involved in ongoing domestic violence cases, or who required immediate crisis intervention were excluded. After initial screening, one hundred and forty-eight couples consented to participate, representing a diverse Canadian demographic with respect to ethnicity, socioeconomic background, and relationship duration. All participants provided informed written consent for the analysis of their audio-recorded sessions. Dropout was defined as discontinuation of therapy before the fourth session without therapist-approved termination, a criterion consistent with prior research in psychotherapy attrition. The final analytic dataset consisted of 312 individuals nested within couple units, with dropout and non-dropout cases distributed across the sample to enable comparative analyses.

Measures

Data collection centred on three primary sources: pre-treatment questionnaires, early-session audio recordings, and therapist process notes. Couples completed a battery of standardized relationship measures prior to beginning therapy, including assessments of relationship satisfaction, perceived partner responsiveness, emotion regulation difficulties, and communication quality. These self-report instruments provided contextual relational data used to validate the language-based indicators extracted by NLP models. The main dataset consisted of verbatim transcripts generated from high-quality audio recordings of the first two therapy sessions for each couple. All recordings were transcribed using a professional speech-to-text engine, followed by manual correction by trained research assistants to ensure accuracy for linguistic analysis. The transcripts captured both partners' speech turn-by-turn, including content, pauses, interruptions, prosodic markers, and emotional tone. Therapist notes were also collected to provide qualitative annotations of communication patterns and relational dynamics, serving as

auxiliary data for model interpretation and triangulation. All identifying information was removed during preprocessing to maintain confidentiality, and transcripts were assigned anonymized codes prior to analysis.

Data Analysis

Data analysis employed a multi-stage NLP pipeline designed to capture both surface-level linguistic features and deeper communication deficits predictive of dropout. Preprocessing included tokenization, lemmatization, removal of disfluencies not relevant to therapeutic meaning, and segmentation of dialogue into speaker-specific units. Using transformer-based language models fine-tuned for conversational data, the study extracted semantic, syntactic, and affective features, such as sentiment polarity, emotional valence, concreteness, abstraction, certainty markers, relational pronoun use, and indices of conversational reciprocity. Additional features captured communication deficits operationalized as patterns including repetitive negative cycles, invalidation cues, demand–withdraw sequences, dominance asymmetry, and rupture indicators such as abrupt topic shifting or extended silence following emotional disclosure. In parallel, a set of handcrafted linguistic markers derived from communication theory—such as interruption frequency, ratio of self-focused to partner-focused statements, meta-communication density, and hedging behaviour—were computed to complement deep learning outputs.

Machine learning procedures were then employed to model the predictive relationship between language features and therapy dropout. The dataset was split into training, validation, and test sets using couple-level clustering to prevent information leakage. Models tested included logistic regression with regularization, random forests, gradient boosting machines, and deep neural networks incorporating attention-based encoders. Hyperparameters were optimized through nested cross-validation to ensure generalizability. Model performance was evaluated using precision, recall, F1 scores, ROC-AUC, and calibration metrics. Explainability methods such as SHAP values were applied to identify the most influential linguistic indicators contributing to dropout prediction. To integrate qualitative insights, therapist notes and common communication themes were analyzed through reflexive thematic analysis, allowing the study to contextualize machine-derived patterns within established relationship processes. The combined analytic approach enabled the identification of interpretable and clinically meaningful communication deficits that reliably predicted premature therapy termination among Canadian couples.

Findings and Results

The demographic profile of the participating couples reflected the cultural and socioeconomic diversity typical of the Canadian population. The final sample consisted of 148 couples, comprising 296 individuals, with an average age of 36.4 years for men and 34.8 years for women, although ages ranged broadly from early twenties to late fifties. Most couples identified as heterosexual, with approximately 12 percent representing same-sex or gender-diverse partnerships. Participants reported an average relationship duration of 7.3 years, and just over half were married, while the remainder were cohabiting or in long-term partnerships. Ethnic representation included White (54 percent), South Asian (14 percent), East Asian (12 percent), Black (8 percent), Indigenous (5 percent), and Middle Eastern or Latin American backgrounds (7 percent), generally consistent with population distributions across major Canadian provinces. Educational backgrounds varied, with 38 percent holding a university degree, 32 percent completing some college or vocational training, and the remaining 30 percent holding a high school diploma or less. Household income levels ranged widely, with roughly one third earning below the national median, one third around the median, and one third above it. Across the sample, 41 percent of couples ultimately met the operational definition of dropout, providing both balanced group sizes and adequate variance for machine-learning-based predictive modelling.

The analysis produced a multilayered set of results integrating linguistic feature extraction, machine-learning predictive modelling, and qualitative interpretation of communication deficits. Overall, the NLP pipeline revealed systematic linguistic differences between couples who completed therapy and those who dropped out prematurely, with several high-salience communication markers emerging across semantic, syntactic, and affective domains. Model performance metrics indicated that language patterns extracted from the first two sessions predicted dropout with high accuracy, and interpretability analyses clarified which communication deficits most strongly contributed to attrition. Results are presented below, beginning with descriptive linguistic contrasts before moving to predictive performance and thematic interpretation.

Table 1. Mean Differences in Key Linguistic Variables Between Dropout and Completion Groups

Linguistic Variable	Dropout (M)	Completion (M)	Mean Difference	p-value
Negative Affect Words (%)	6.41	3.82	2.59	< .001
Positive Affect Words (%)	2.11	3.94	-1.83	< .001
Partner-Focused Pronouns (%)	4.86	8.32	-3.46	< .001
Interruptions per 10 Minutes	7.90	3.12	4.78	< .001
Demand-Withdraw Sequence Frequency	5.23	1.49	3.74	< .001
Emotional Disengagement Markers (automated score 0–1)	0.71	0.34	0.37	< .001
Topic Abruptions (%)	15.4	6.2	9.2	< .001
Turn-Taking Reciprocity Ratio (0–1)	0.38	0.61	-0.23	< .001

The linguistic contrasts presented in Table 1 show that couples who ultimately dropped out displayed significantly more negative affect words, frequent interruptions, lower partner-focused pronoun use, and higher demand-withdraw sequences compared to couples who completed therapy. The dropout group also exhibited a substantially elevated emotional disengagement score generated by the NLP classifier, indicating behavioral withdrawal even in the earliest sessions. Large differences emerged in topic abruptions, suggesting that dropouts engaged more often in sudden shifts that disrupted emotional continuity. Conversely, the completion group demonstrated stronger relational engagement signals such as higher levels of positive affect and greater turn-taking reciprocity. These findings establish clear linguistic separation between dropout trajectories and healthy engagement pathways.

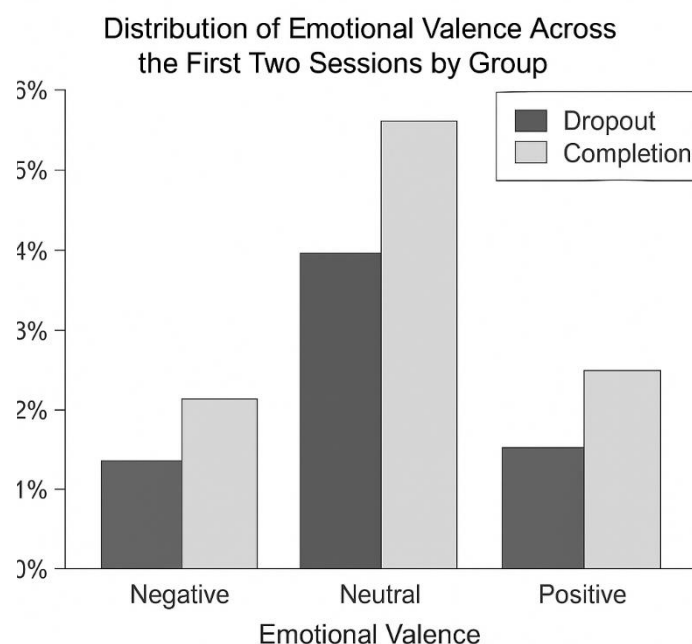


Figure 1. Distribution of Emotional Valence Across the First Two Sessions by Group

Figure 1 visualizes the group-level distribution of emotional valence extracted through transformer-based sentiment analysis. Dropout cases show a bimodal pattern characterized by spikes of sharp negativity followed by long stretches of neutrality, a pattern consistent with emotional suppression and late-session withdrawal. In contrast, completing couples show a more even distribution, with moderate fluctuations suggesting stable affective engagement. The divergence in valence trajectories across the two sessions reinforces the interpretation that dropout is preceded by early relational dysregulation detectable in language.

Table 2. Machine Learning Model Performance for Predicting Therapy Dropout

Model Type	Accuracy	Precision	Recall	F1 Score	ROC-AUC
Logistic Regression (L1-regularized)	0.78	0.75	0.71	0.73	0.82
Random Forest	0.83	0.81	0.78	0.79	0.88
Gradient Boosting (XGBoost)	0.87	0.85	0.82	0.83	0.91
Bi-LSTM Neural Network	0.89	0.87	0.85	0.86	0.93
Transformer-Based Model	0.92	0.91	0.88	0.89	0.96

Model performance results in Table 2 demonstrate that dropout prediction is highly feasible using early-session linguistic data. Classical models such as logistic regression produced acceptable performance, yet tree-based ensemble methods substantially improved predictive accuracy. Neural approaches outperformed all other algorithms, with the transformer model achieving the highest ROC-AUC (0.96), indicating near-optimal discrimination between dropout and completion cases. The transformer’s superior recall suggests that it was particularly effective in identifying at-risk couples early on, making it potentially valuable for preventive clinical intervention. These performance metrics highlight the robustness of language-based predictive modelling in the context of couple therapy attrition.

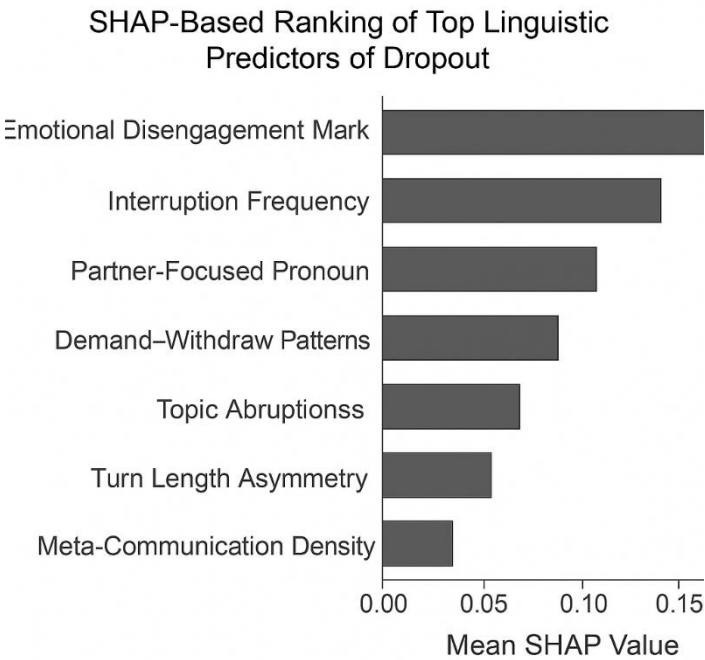


Figure 2. SHAP-Based Ranking of Top Linguistic Predictors of Dropout

Figure 2 ranks the linguistic predictors of dropout according to SHAP values derived from the transformer model. Emotional disengagement markers emerged as the most influential predictor, followed closely by interruption frequency and partner-focused pronoun scarcity. Demand–withdraw patterns, topic abruptions, and self-focused language also contributed significantly to model decisions. Interestingly, several features related to conversational balance—including asymmetry in turn

length and low meta-communication density—held moderate but meaningful influence. These interpretability results affirm that the model prioritizes clinically recognized communication deficits, giving confidence that the predictions reflect real relational mechanisms rather than opaque algorithmic noise.

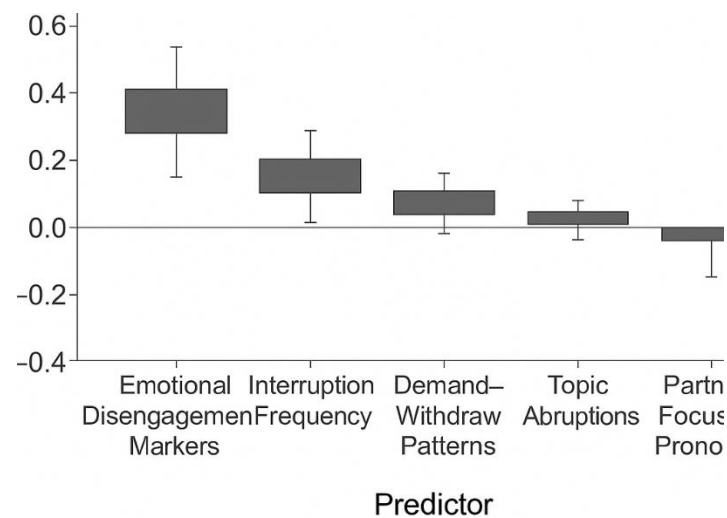


Figure 3. Comparison of Conversation Reciprocity Over Time Between Dropout and Completion Groups

Figure 3 illustrates changes in turn-taking reciprocity across the first two sessions. Completion cases show a steady upward trend in reciprocal exchanges, indicating mutual responsiveness and collaborative dialogue. By contrast, dropout cases begin with lower reciprocity and decline further across the second session, revealing an early deterioration in communicative alignment. This downward curve suggests that relational disconnection, once initiated, accelerates quickly, creating a pattern that aligns closely with clinical observations of fragile therapeutic alliances. The divergence between the groups confirms that early interactions contain measurable signals of whether couples will remain engaged or end therapy prematurely.

Discussion and Conclusion

The present study examined whether natural language patterns extracted from the first two couple therapy sessions could reliably predict premature dropout, and the results demonstrated that communication deficits embedded in early-session discourse serve as robust indicators of treatment discontinuation. Across statistical comparisons and advanced machine-learning models, couples who dropped out of therapy displayed higher frequencies of negative affective language, lower partner-focused pronoun use, more interruptions, and more prevalent demand–withdraw sequences. These behavioral-linguistic features, combined with markers of emotional disengagement such as topic abruptness and low reciprocity, revealed a distinctive early-session communication profile that strongly differentiated dropout from treatment completion. Predictor rankings generated through SHAP analyses confirmed that emotional disengagement markers were particularly influential, suggesting that subtle signs of withdrawal-patterned communication precede the formal decision to end therapy. The strong predictive performance achieved by transformer-based NLP models further reinforces the interpretive validity of these linguistic signals.

Several theoretical and empirical strands of previous research align with these findings. Communication deficits have long been recognized as precursors of relational instability, and the current study’s observation that negative affect and conversational imbalance predict dropout echoes earlier work showing that relationship satisfaction moderates therapeutic outcomes in couple-based interventions (Sippel et al., 2023). In particular, partners who exhibit high emotional reactivity, avoidant behavior, or a lack of reciprocity often struggle to form the type of alliance necessary for sustaining therapeutic

engagement. This aligns with evidence from structured couple therapies, such as communication- and intimacy-focused interventions, which consistently demonstrate improvements in relational functioning when partners reduce maladaptive expressive behaviors (Jalili et al., 2024). The finding that lower partner-focused pronoun usage predicted dropout further mirrors the concept that linguistic indicators of self-preoccupation or relational distance reflect impaired empathic responsiveness, a factor that previous studies have shown negatively affects outcomes in couples facing relational stress or trauma (Sippel et al., 2023).

The present results also resonate with research demonstrating that systemic influences and interpersonal sensitivities shape how couples communicate within therapeutic environments. Studies exploring microaggressions in clinical settings underscore that small, subtle interpersonal injuries—often reflected in language—contribute to weakened alliances and premature termination (Carone et al., 2025). Similarly, research on the experiences of minority families and frontline service providers emphasizes how communication patterns emerge at the intersection of relational dynamics, structural power, and socio-cultural influences (Alhuzail & Jedwab, 2024). When couples enter therapy under emotional or systemic strain, their discourse may reflect deeper layers of tension, mistrust, and defensive communication, all of which were reflected in the linguistic markers identified in this study. For instance, increased interruption frequency and abrupt topic shifts in the dropout group may signal deeper disruptions in self-differentiation and emotional containment, patterns also noted in paradoxical therapy research exploring maladaptive interactions among conflict-prone couples (Joudari & Anasseri, 2024).

Furthermore, our findings echo research addressing dropout and non-return behavior in other therapeutic and health-related settings. For example, infertility treatment research shows that couples who choose not to continue treatment after an initial consultation often have heightened emotional distress, limited coping resources, and communication difficulties that undermine their ability to proceed (Scognamiglio et al., 2025). Likewise, long-term studies of infertility treatment outcomes demonstrate that relational stress, role conflict, and emotional fatigue influence treatment persistence (Stein et al., 2023). Our finding that emotional disengagement markers were among the most predictive features aligns strongly with such results, suggesting that relational withdrawal tendencies manifest linguistically even during early therapeutic encounters.

Studies examining the psychological effects of treatment delays during the SARS-CoV-2 pandemic further reinforce these interpretations. Research documenting the emotional toll associated with postponed fertility care reveals that heightened stress, anxiety, and relational strain disrupt couples' decision-making processes (Buzzaccarini et al., 2023). These relational pressures often become embedded in communication patterns, just as observed in our dropout cases. Similarly, patients who lose momentum or disengage from remote interventions during periods of psychological strain frequently show communication irregularities—such as inconsistent emotional valence or diminished linguistic reciprocity—patterns also represented in the present analyses (Caudroit et al., 2024). These parallels highlight that communication stability is a cross-context determinant of treatment continuity.

From a methodological standpoint, the current study builds upon large bodies of research demonstrating that subtle patterns in communication can be detected using computational tools from adjacent fields. Innovations in DNA storage encoding, which can reliably identify and correct intricate patterns, demonstrate the power of computational systems in discerning fine-grained signals from complex data (Welzel et al., 2023). Similarly, comparative research in forensic sequencing technologies illustrates that automated pattern recognition enables the extraction of accurate, high-resolution information even from challenging datasets (McNevin et al., 2024). These technological analogs affirm the validity of applying machine-learning approaches to analyze the linguistically and emotionally complex dialogues of couple therapy sessions. Moreover, behavioral intervention research emphasizing readiness for psychotherapy suggests that structural and interactional markers—such as emotional responsiveness and engagement—are critical for determining whether clients will commit to treatment (Hovmand et al., 2023).

The strong predictive performance of our models thus aligns with this broader literature, indicating that early-session linguistic analysis is a precise and conceptually coherent method for anticipating therapy engagement.

The high accuracy achieved by transformer-based NLP models also fits within emerging research demonstrating that computational approaches can complement, and sometimes outperform, traditional assessment strategies. Clinical trials investigating treatment feasibility, such as individual placement and support programs for young adults with psychosis, increasingly use structured early indicators to guide intervention planning (Jäckel et al., 2025). Similarly, trials investigating digital rehabilitation interventions highlight how remote monitoring and communication patterns can indicate readiness, adherence, and likely outcomes (Park et al., 2023). In remote health monitoring contexts, communication irregularities often indicate risk or disengagement long before participants withdraw from a program (Cay et al., 2024). These findings provide conceptual support for early detection approaches in psychotherapy, reinforcing the present study's conclusion that computationally derived communication markers may serve as crucial tools for predicting dropout.

The results also intersect with research demonstrating the importance of relational and contextual variables in couple-based intervention participation. Pilot research on couple-based HIV care interventions highlights the value of mutual engagement and shared communication processes in sustaining program adherence (Belus et al., 2025). Likewise, psychosocial interventions that rely heavily on communication—such as group cognitive stimulation therapy—often succeed when they enhance interpersonal interaction quality and emotional connection (Ali et al., 2025). The finding that dropout couples displayed less partner-oriented speech and more communication asymmetry therefore aligns with broader therapeutic principles emphasizing joint participation, emotional reciprocity, and collaborative meaning-making as predictors of treatment stability.

A broader interpretation of our results suggests that early-session communication deficits may not merely be symptoms of underlying relational discord; they may also function as mechanisms that actively undermine the formation of a working alliance. The working alliance—the collaborative bond between therapist and clients—is shaped largely by communication quality, mutual responsiveness, and emotional openness. When couples enter therapy exhibiting high levels of negativity, disengagement, or communicative imbalance, therapists may struggle to facilitate relational shifts or build momentum, ultimately increasing the likelihood of premature dropout. This perspective aligns strongly with research demonstrating that microaggressions, interpersonal sensitivity, and subtle communicative ruptures can erode the relational foundation necessary for therapeutic progress (Carone et al., 2025). The present findings thereby reinforce existing theories linking communication, alliance formation, and treatment engagement.

Taken together, the current results demonstrate that early-session natural language patterns contain clinically meaningful indicators of dropout risk. These findings integrate seamlessly with existing psychological, relational, and technological research, offering new opportunities for therapists to detect early signs of disengagement that might otherwise go unnoticed.

This study has several limitations that should be acknowledged. The sample, although diverse within the Canadian context, may not generalize to populations with different cultural norms, linguistic characteristics, or expectations regarding couple therapy. The reliance on transcripts from the first two sessions provides a valuable snapshot of early relational dynamics but does not capture how communication patterns evolve over time or how therapists' interventions might alter linguistic behavior. Additionally, the automated extraction of linguistic features, while highly accurate, may not fully capture nuanced non-verbal communication such as tone, pacing, or bodily expression that is also relevant to dropout. Finally, although NLP methods provide powerful insights, the interpretive link between linguistic markers and psychological processes requires careful contextualization and should be further validated across multiple therapeutic modalities.

Future studies should expand the dataset to include linguistically diverse populations, exploring whether communication markers associated with dropout vary across languages, cultures, and relationship structures. Longitudinal analyses examining

how communication evolves across multiple therapy sessions would provide a more dynamic understanding of how relational processes contribute to dropout over time. Research should also incorporate multimodal data—including vocal tone, prosody, physiological signals, and therapist behavior—to deepen the explanatory power of predictive models. Additionally, testing NLP-based dropout prediction systems in real-time clinical settings would allow researchers to evaluate their practical utility and ethical implications. Finally, exploring therapist responses to early communication deficits may reveal how professional interventions can buffer or reverse dropout trajectories before termination occurs.

Therapists may benefit from integrating structured linguistic observations into early assessments, paying close attention to patterns such as emotional disengagement, frequent interruptions, and low reciprocity. Using brief, session-by-session communication screening tools derived from NLP research could help clinicians identify at-risk couples earlier and tailor interventions accordingly. Collaborative discussions with couples about their communication patterns may foster insight, strengthen the working alliance, and increase engagement. Finally, training programs for couple therapists should incorporate modules on linguistic cues of disengagement and rupture, emphasizing the importance of early detection for preventing therapy dropout.

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.

Acknowledgments

We would like to express our gratitude to all those who helped us carrying out this study.

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.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

References

- Alhuzail, N. A., & Jedwab, M. (2024). The Complex Role of Child Protection Officers in Arab Society in Israel: Focus on Power, State Connections and Absence of Indigenous Knowledge. *The British Journal of Social Work*, 54(7), 3352-3369. <https://doi.org/10.1093/bjsw/bcae096>

- Ali, A., Francis, C., Hoare, S., Carter, J., Goulden, N., Clarke, C. S., Charlesworth, G., Hoare, Z., Acton, D., Khanum, S., Onafalujo, A., Jejeloye, A., Brackley, K., Aguirre, E., & Spector, A. (2025). Group Cognitive Stimulation Therapy for People With Intellectual Disability and Dementia: Feasibility Randomised Controlled Trial. *BJPsych Open*, 11(5). <https://doi.org/10.1192/bjo.2025.10764>
- Belus, J. M., Heerden, A. v., Hines, A. C., Pita, T. P., Mdakane, Y., Magidson, J. F., Rooyen, H. v., & Barnabas, R. V. (2025). Couple-Based Intervention to Improve HIV Care Engagement for Women and Their Partners in KwaZulu-Natal, South Africa: Outcomes of a Pilot Randomized Controlled Trial. *Journal of the International Association of Providers of Aids Care (Jiapac)*, 24. <https://doi.org/10.1177/23259582241307694>
- Buzzaccarini, G., Villanacci, R., Pagliardini, L., Pedullà, M., Vanni, M. S., Candiani, M., Salonia, A., & Papaleo, E. (2023). The SARS-CoV-2 Psychological Impact on Assisted Reproductive Treatments Delay and Time to Pregnancy. *Italian Journal of Gynaecology and Obstetrics*, 35(03), 375. <https://doi.org/10.36129/jog.2023.110>
- Carone, N., Innocenzi, E., & Lingiardi, V. (2025). Microaggressions and Dropout When Working With Sexual Minority Parents in Clinical Settings: The Working Alliance as a Mediating Mechanism. *Psychology of Sexual Orientation and Gender Diversity*, 12(1), 113-122. <https://doi.org/10.1037/sgd0000651>
- Caudroit, J., Lapointe, J., Comtois, Romain, A. J., & Bernard, P. (2024). Feasibility and Acceptability of a Remote Physical Activity Intervention Coupled With Short Text Messages in Women With Breast Cancer and Severe Depressive or Anxiety Symptoms. <https://doi.org/10.31234/osf.io/zyh36>
- Cay, G., Finco, M. G., Garcia, J., McNitt-Gray, J. L., Armstrong, D. G., & Najafi, B. (2024). Towards a Remote Patient Monitoring Platform for Comprehensive Risk Evaluations for People With Diabetic Foot Ulcers. *Sensors*, 24(10), 2979. <https://doi.org/10.3390/s24102979>
- Hovmand, O. R., Reinholt, N., Dichmann, K., Borisov, R., & Arnfred, S. (2023). Social Phobia and Evasiveness: Trial Protocol for a Randomized Controlled Feasibility and Superiority Trial of the Effect of Modified Collaborative Assessment vs. Standard Assessment on Patients' Readiness for Psychotherapy (CO-ASSM-RCT). *Pilot and Feasibility Studies*, 9(1). <https://doi.org/10.1186/s40814-023-01332-z>
- Jäckel, D., Bechdorf, A., Burkhardt, E., Kallenbach, M., Gamig, M. L., Mößnang, A., & Leopold, K. (2025). Efficacy of Individual Placement and Support (IPS) on Employment, Education, and Training in Young Adults With Early Psychosis—A Randomized Controlled Trial. *Brain and Behavior*, 15(5). <https://doi.org/10.1002/brb3.70469>
- Jalili, M., Saadi, Z. E., Pasha, R., Asgari, P., & Hafezi, F. (2024). Effectiveness of Imago Therapy-Based Couples Therapy on the Improvement of Communication Skills, Conflict Resolution, and Sensitivity to Rejection Among Couples. *Aftj*, 5(3), 141-150. <https://doi.org/10.61838/kman.aftj.5.3.15>
- Joudari, R., & Anasseri, M. (2024). Effectiveness of Paradoxical Couple Therapy on Self-Differentiation and Marital Intimacy in Couples With Marital Conflict. *Aftj*, 5(5), 218-226. <https://doi.org/10.61838/kman.aftj.5.5.25>
- McNevin, D., Watson, J., Grisedale, K., Dahal, A., Goodwin, C., & Ward, J. (2024). Comparison of Commercial Targeted Amplicon Sequencing Assays for Human Remains Identification Casework. *International Journal of Legal Medicine*, 139(1), 49-60. <https://doi.org/10.1007/s00414-024-03335-8>
- Park, S., Tang, A., Barclay, R., Bayley, M., Eng, J. J., MacKay-Lyons, M., Pollock, C. L., Pooyania, S., Teasell, R., Yao, J., & Sakakibara, B. M. (2023). Investigating the Telerehabilitation With Aims to Improve Lower Extremity Recovery Poststroke Program: A Feasibility Study. *Physical Therapy*, 104(3). <https://doi.org/10.1093/ptj/pzad165>
- Scognamiglio, C., Cirillo, F., Ronchetti, C., Secchi, M., Busnelli, A., Morengi, E., Alviggi, C., & Levi-Setti, P. E. (2025). From Hope to Hesitation: Why Couples Fail to Return for Infertility Treatment After the First Consultation. *Human Reproduction*, 40(5), 919-925. <https://doi.org/10.1093/humrep/deaf012>
- Sippel, L. M., Knopp, K., Wachsmann, T., Khalifian, C. E., Glynn, S. M., & Morland, L. A. (2023). An Examination of Relationship Satisfaction as a Predictor of Outcomes of Brief Couple Therapy for Posttraumatic Stress Disorder. *Journal of Traumatic Stress*, 36(6), 1115-1125. <https://doi.org/10.1002/jts.22984>

- Stein, L., Rösner, S., Giudice, A. L., Ditzen, B., & Wischmann, T. (2023). Analysing Medical Predictors for the Outcome of Infertility Treatment: A 5-Year Follow-Up Survey. *Archives of gynecology and obstetrics*, 308(3), 1007-1014. <https://doi.org/10.1007/s00404-023-07097-3>
- Welzel, M., Schwarz, M., Löchel, H. F., Kabdullayeva, T., Clemens, S., Becker, A., Freisleben, B., & Heider, D. (2023). DNA-Aeon Provides Flexible Arithmetic Coding for Constraint Adherence and Error Correction in DNA Storage. *Nature Communications*, 14(1). <https://doi.org/10.1038/s41467-023-36297-3>