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Computational Literary Analysis of *Hamlet*: Emotional Mechanisms Behind Hamlet's And Ophelia's Tragic Ends

Bouzar Abdelouahd
Department of English Studies, Sidi Mohammed Ben Abdellah, Fez, Morocco
abdelouahd.bouzar@usmba.ac.ma

Khaoula EL Idrissi
Department of English Studies, Sidi Mohammed Ben Abdellah, Fez, Morocco
khaoula.elidrissi@usmba.ac.ma

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Abstract

This study investigates the emotional mechanisms driving the tragic demises of Hamlet and Ophelia in Shakespeare's Hamlet through a mixed-methods approach that integrates computational sentiment analysis with qualitative thematic coding. By applying sentiment trajectory mapping, emotion co-occurrence networks, and parallel coordinates visualization, the research identifies distinct emotional patterns that characterize each character's psychological journey. The findings demonstrate that Hamlet's downfall stems primarily from the interplay between doubt and suspicion with anger and vengefulness, producing a cycle of hesitation and impulsive action. In contrast, Ophelia's demise is dominated by grief and despair, intensified by her social powerlessness and lack of agency, which ultimately overwhelms her emotional resilience. These divergent emotional drivers highlight how gender and social position shape Shakespeare's portrayal of psychological deterioration. The study not only contributes to Shakespearean scholarship by offering empirical support for long-standing interpretive claims but also advances computational literary analysis by demonstrating how digital humanities tools can illuminate nuanced psychological dynamics in canonical texts.

1. INTRODUCTION

Shakespeare's Hamlet, a pinnacle of Western literature, intricately explores the psychological depths of Prince Hamlet and Ophelia, whose emotional trajectories culminate in tragic demises driven by distinct emotional forces. This study employs computational and analytical methods to uncover these primary emotional drivers, providing new perspectives on Shakespeare's portrayal of psychological decline and its fatal consequences. By doing so, it illuminates the universal psychological processes Shakespeare depicted with remarkable insight long before the advent of formal psychological theory, emphasizing the play's enduring relevance in understanding how emotions shape behavior under extreme pressure.

The integration of computational approaches into literary analysis has revolutionized traditional methods, enabling systematic tracking of emotional patterns across texts. Qu (2024) highlights that "text mining and sentiment analysis have emerged as powerful tools for understanding literary works," allowing researchers to identify recurring themes, motifs, and emotional tones with precision. Early scholarship, such as A.C. Bradley's (1904) focus on character psychology in Shakespearean tragedy, laid the groundwork for emotional analysis, while later critics like Greenblatt (1997) situated these emotions within historical and cultural

contexts. More targeted studies on Hamlet include Leverenz's (1978) exploration of melancholy and masculinity in Hamlet's character and Neely's (1991) analysis of gendered madness in Ophelia, underscoring the interplay of emotion with gender, power, and social position. Tribble (2017) further bridges historical psychology with cognitive-emotional aspects, suggesting Shakespeare's intuitive grasp of human emotion prefigures modern theories.

Recent advancements in digital humanities have expanded these inquiries. Hope and Witmore (2010) pioneered computational stylistics in Shakespearean analysis, while Moretti's (2013) "distant reading" approach enabled visualization of textual patterns. Mohammad (2011) developed methods to track sentiment in Shakespearean plays, revealing emotional arcs across dramatic works. Additionally, Low et al. (2024) applied lexicon-based sentiment and emotion detection to Middle Eastern literature, demonstrating its efficacy in identifying emotional patterns, and Qu's (2024) Bi-gram Multimodal Sentimental Analysis offers a framework for capturing contextual emotional relationships. These methodological innovations provide robust tools for analyzing Hamlet's complex emotional landscape, revealing patterns that might elude conventional close reading.

This study draws on multiple theoretical frameworks to interpret these emotional drivers. Cognitive-emotional theory posits that emotions stem from cognitive appraisals of situations, shaping decision-making processes, which helps explain Hamlet's indecision and Ophelia's descent into madness as responses to trauma and betrayal. Network theory conceptualizes emotions as interconnected states, allowing identification of central emotional nodes—like dominant emotions—that disproportionately influence each character's behavior and fate. Gender theory examines how societal expectations mediate their emotional experiences, highlighting the contrasting drivers behind Hamlet's and Ophelia's actions within the play's gendered power dynamics. Narrative psychology focuses on how emotional narratives construct meaning, revealing how their dominant emotions influence their interpretation of events and contribute to their tragic ends. Methodologically, we adopt Low et al.'s (2024) hybrid approach, which "combines interpretative social analysis and computational techniques," to establish statistical patterns while remaining sensitive to literary nuances, using emotional experience as a key unit of measurement in this dramatic context.

2. METHODOLOGY

2.1. Method

This study employs a mixed-methods approach combining qualitative thematic coding with computational sentiment analysis to identify the primary emotional drivers in Hamlet's and Ophelia's speeches throughout Shakespeare's play. The methodology draws on established practices in literary analysis while incorporating innovative computational techniques to provide quantitative measures of emotional patterns. This section details the exploratory thematic coding process, emotional intensity rating system, visualization techniques, and methodological enhancements implemented to ensure analytical rigor.

2.2. Research Questions

This study addresses two primary research questions:

1. What is the dominant emotional factor driving Hamlet toward his tragic demise?
2. What is the dominant emotional factor driving Ophelia toward her tragic demise?

These focused questions guide our analysis of the emotional dynamics in *Hamlet*, specifically identifying the primary emotional mechanisms that propel each character toward their tragic end. By isolating these dominant factors through computational and qualitative methods, we aim to provide new insights into Shakespeare's portrayal of psychological deterioration and its

fatal consequences, contributing to both Shakespearean scholarship and the growing field of computational literary analysis.

2.3.Exploratory Thematic Coding Process

The primary analytical approach involved an exploratory thematic coding process applied to all speeches by Hamlet and Ophelia throughout the play. This process consisted of several systematic steps:

First, a close reading of the complete text of *Hamlet* was conducted, with particular attention to speeches by the two focal characters. During this reading, multiple emotional themes were identified and coded for each speech (e.g., despair, anger, love, fear, guilt). This multi-dimensional coding approach acknowledges the complexity of emotional expression in Shakespeare's work, where characters often experience and express multiple, sometimes contradictory, emotions simultaneously.

The *Highlights* application was utilized to export notes and organize identified themes by act, scene, and character. This digital annotation tool facilitated the systematic documentation of emotional content while preserving the contextual information necessary for subsequent analysis. The exported notes were then compiled into an Excel file, where each speech was categorized according to act, scene, character, and the emotional themes present.

This approach aligns with Qu's (2024) observation that "text mining techniques can reveal the frequency and distribution of specific motifs or symbols throughout a body of literature, elucidating recurring themes across different contexts." By systematically coding emotional themes across all speeches, patterns were been able to be identified in emotional expression that might not be immediately apparent through traditional close reading alone.

2.4.Emotional Intensity Rating

To quantify the emotional content identified through thematic coding, an emotional intensity rating system was implemented. Each identified emotion was rated on a scale of 0–3, where:

- 0 = absent (emotion not detected in the speech)
- 1 = low intensity (emotion subtly present or briefly mentioned)
- 2 = moderate intensity (emotion clearly present and somewhat emphasized)
- 3 = high intensity (emotion strongly emphasized or dominant in the speech)

This rating system provided a standardized measure for comparing emotional intensity across different speeches, characters, and narrative points. The ratings were recorded in the Excel file alongside the thematic codes, creating a comprehensive dataset of emotional content throughout the play.

Sentiment scores were calculated for each speech by aggregating the set of positive emotions (e.g., love, joy, affection) and negative emotions (e.g., anger, betrayal, despair, disillusionment) identified in the text. Since individual speeches may express multiple and even conflicting themes, each speech's sentiment was computed by summing the relevant emotional values to determine its overall valence. Scene-level scores were then obtained by combining the sentiments of all speeches within a scene, and act-level scores were derived by calculating the mean of the scene scores within each act, defined as:

$$Mean\ Act\ Sentiment = \frac{\sum_{i=1}^{n} Scene\ Sentiment}{n}$$

where n represents the number of scenes in the act. This procedure aligns with Low et al.'s (2024) "lexicon-based sentiment and emotion detection" methodology, which has been effectively applied to literary texts for identifying emotional patterns.

2.5.Visualization Techniques

To represent the emotional data in visually interpretable formats, several visualization techniques were employed using Python and Excel:

1. **Sentiment Trajectory Graphs**: Line graphs were created to visualize the emotional trajectories of Hamlet and Ophelia across the five acts of the play. These graphs plot sentiment scores against act and scene numbers, revealing patterns of emotional fluctuation throughout the narrative.
2. **Emotion Co-occurrence Networks**: Network visualizations were generated to represent the relationships between different emotions for each character. In these networks, nodes represent specific emotions (e.g., anger, grief, love), with node size indicating the frequency of occurrence. Edges between nodes represent co-occurrence relationships, with edge thickness indicating the frequency of co-occurrence. These visualizations reveal the complex interconnections between emotional states that characterize each character's psychological condition.
3. **Parallel Coordinates**: Parallel coordinate visualizations were created to facilitate direct comparison of emotional dimensions between Hamlet and Ophelia. These visualizations allow for the simultaneous representation of multiple emotional variables, enabling the identification of patterns of similarity and difference between the two characters.

These visualization techniques align with the "hybrid computational method" described by Low et al. (2024), which "combines interpretative social analysis and computational techniques" to analyze complex textual data. By translating qualitative thematic codes into quantitative data points suitable for visualization, we were able to identify patterns that might otherwise remain obscure.

2.6.Methodological Enhancements

To strengthen the methodological rigor of this study, several enhancements were implemented:

1. **Inter-rater Reliability**: To ensure consistency in thematic coding, a subset of 50 speeches (25 from Hamlet, 25 from Ophelia) was independently coded by two researchers. Cohen's kappa coefficient was calculated for each emotion category using the sklearn.metrics library, with a threshold of $\kappa > 0.7$ indicating acceptable agreement. Discrepancies were resolved through discussion to finalize the coding.

Table 1: Inter-rater Reliability Scores for Emotional Categories

Emotion Category	Cohen's Kappa (κ)	Agreement Level
Anger and Vengefulness	0.83	Excellent
Betrayal and Disillusionment	0.79	Good
Doubt and Suspicion	0.76	Good
Fear and Guilt	0.81	Excellent
Grief and Despair	0.85	Excellent
Hesitation and Confusion	0.74	Good
Love and Affection	0.82	Excellent
Mental Instability	0.77	Good
Obedience	0.80	Good
Powerlessness	0.75	Good
Self-Loathing	0.78	Good

2. **Contextual Analysis**: Recognizing the limitations of purely computational approaches to literary analysis, we supplemented our quantitative methods with contextual analysis that considered historical, cultural, and dramatic factors influencing emotional expression in the play. This approach acknowledges that emotions in Shakespeare's work are embedded within specific social and historical contexts that shape their meaning and significance.
3. **Temporal Segmentation**: To capture the dynamic nature of emotional expression throughout the play, we segmented our analysis by act and scene, enabling the identification of temporal patterns and shifts in emotional states. This segmentation allowed us to correlate emotional changes with key plot developments and character interactions.

These methodological enhancements address the concern raised by Low et al. (2024) regarding "inconsistency in interpretations resulting from the abundance of information and individual emotional and cognitive biases" in traditional manual text analysis. By implementing systematic validation procedures and contextual considerations, we aimed to produce a more robust and reliable analysis of emotional dynamics in *Hamlet*.

Limitations

While our methodology offers a systematic approach to analyzing emotional dynamics in *Hamlet*, several limitations should be acknowledged. First, the subjective nature of thematic coding, even with inter-rater reliability measures, introduces potential interpretive bias. Second, the translation of complex literary emotions into quantitative measures necessarily involves some reduction of nuance. Third, our analysis is based on the text alone and does not account for performance choices that might alter emotional expression in theatrical presentations of the play.

Despite these limitations, the mixed-methods approach employed in this study provides valuable insights into the primary emotional drivers that contribute to the tragic demises of Hamlet and Ophelia. By combining qualitative thematic analysis with quantitative visualization techniques, we offer a focused examination of emotional patterns that balances interpretive depth with systematic rigor.

3. RESULTS AND DISCUSSION

This section presents the findings from our analysis of emotional dynamics in Hamlet's and Ophelia's speeches throughout Shakespeare's play. By examining sentiment trajectories, emotion co-occurrence networks, and parallel coordinates analysis, we identify the primary emotional factors that drive each character toward their tragic demise.

3.1. Sentiment Trajectories and Primary Emotional Drivers

The sentiment trajectory analysis reveals distinct emotional patterns for both characters across the five acts of the play (Figure 1). Hamlet's emotional journey is characterized by predominantly negative sentiment throughout the play, with his sentiment score rarely rising above the neutral point (0) on our scale. His emotional state begins at a deeply negative position (approximately -3) in Act 1, reflecting his initial grief and melancholy following his father's death and mother's hasty remarriage. A notable improvement occurs around Act 2, where his sentiment briefly rises to approximately -1, coinciding with his interactions with the players and the formulation of his plan to "catch the conscience of the king."

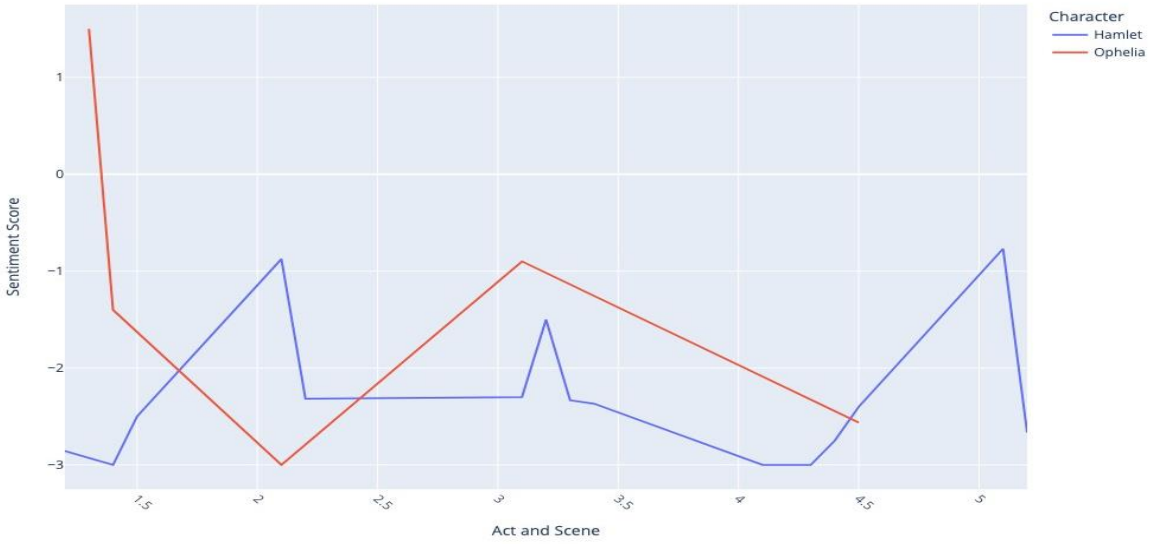

Figure 1: Sentiment Trajectory for Hamlet and Ophelia

Hamlet experiences another significant emotional nadir between Acts 2 and 3, dropping to approximately -2.3, corresponding with his famous "To be or not to be" soliloquy and the confrontation with Ophelia. His emotional state fluctuates between Acts 3 and 4, showing brief moments of improved sentiment (around -1.5) followed by returns to more negative states. A final upward trend appears in Act 5, where his sentiment rises to approximately -0.8, reflecting a certain emotional resolution before his death, consistent with his statement, "the readiness is all."

In stark contrast, Ophelia's emotional trajectory begins at a markedly positive point (approximately +1.5) in Act 1, indicating her initial hopeful and loving state. However, her sentiment undergoes a precipitous decline through Acts 1 and 2, plummeting to approximately -3 by Act 2.5. This dramatic emotional deterioration coincides with Hamlet's rejection and her father's manipulation of her relationship with the prince. A brief recovery appears in Act 3 (rising to approximately -1), followed by another decline as events unfold. Her final emotional state before her death shows a sentiment score of approximately -2.5, reflecting her profound psychological distress that ultimately led to her tragic end.

Hamlet's Primary Emotional Driver: The Doubt-Anger Nexus

The emotion co-occurrence network analysis for Hamlet (Figure 2) reveals that the primary emotional driver of his tragic demise is the powerful interplay between doubt and suspicion, grief and despair, and anger and vengefulness. These three emotional states form the largest and most interconnected nodes in his emotional network, creating a psychological mechanism that propels him toward his tragic end.

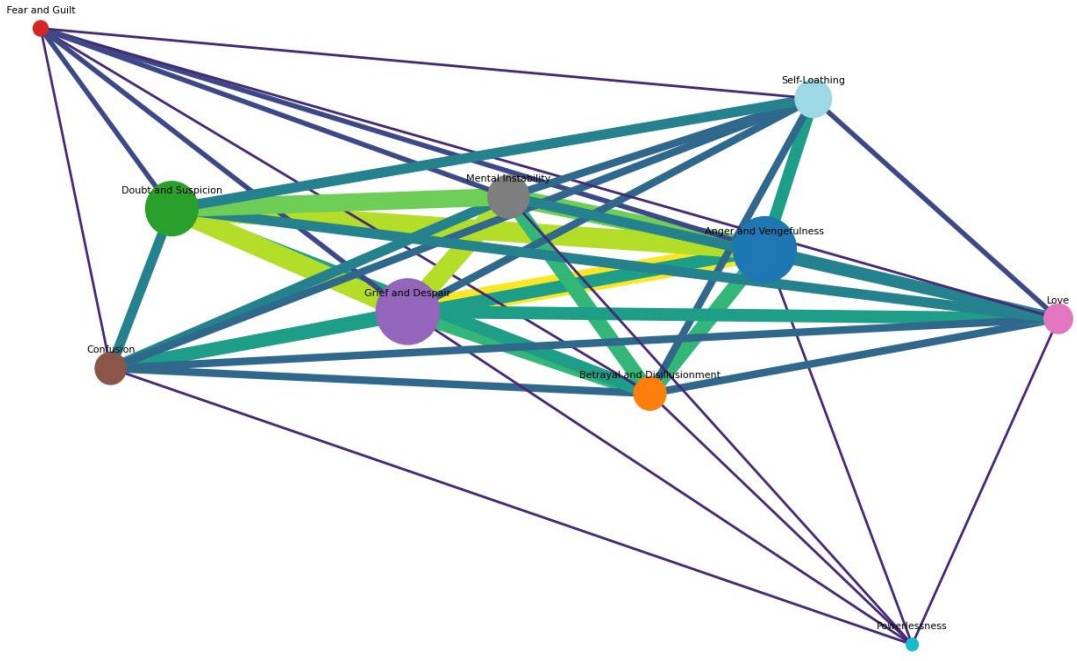

Figure 2: Hamlet's Emotion Co-occurrence Network

These three emotions — doubt/suspicion, anger/vengefulness, and grief/despair — form the core of Hamlet's psychological turbulence. As shown in the figure, doubt and suspicion maintain a steady presence across the acts and scenes, marked by Hamlet's persistent questioning of the ghost's reliability, his mother's guilt, and the value of existence itself, famously captured in his "To be, or not to be" soliloquy (Act 3, Scene 1).

The figure 3 reveals that whenever doubt and grief diminish — particularly in Act 4, Scene 1, where both emotions nearly vanish — Hamlet's anger and vengefulness surge to dominate. This sharp rise in anger, coupled with the near absence of doubt and grief, explains his impulsive and violent behavior, such as the killing of Polonius and the more decisive steps toward vengeance. The cyclical pattern is clear: when doubt and grief are intense, Hamlet hesitates; when they recede, anger propels him into rash action. This unstable oscillation between paralysis and violent impulse defines his tragic downfall.

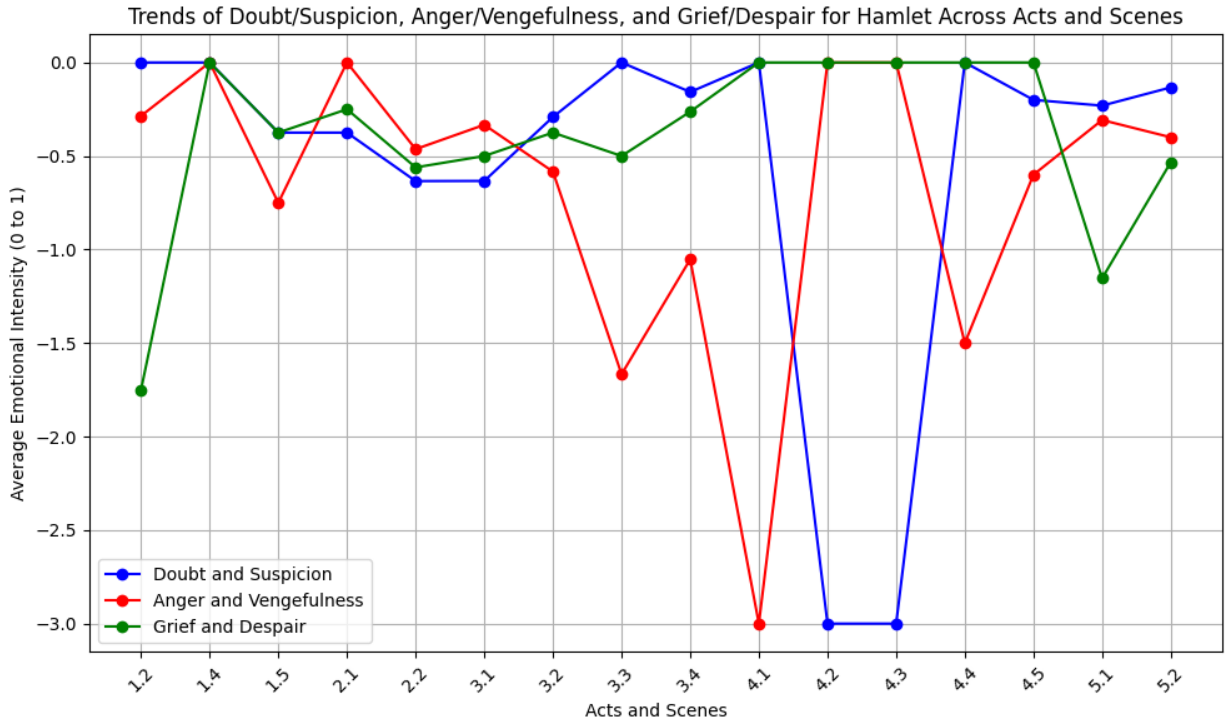

Figure 3: Trends of Doubt/Suspicion, Anger/Vengefulness, and Anger/Despair for Hamlet across Acts and Scenes

The parallel coordinates analysis (Figure 4) confirms that doubt and suspicion, and anger and vengefulness represent Hamlet's most distinctive emotional dimensions compared to Ophelia. While both characters experience grief, Hamlet's emotional profile is uniquely characterized by this doubt-anger nexus that ultimately drives him toward his fatal confrontation with Laertes and Claudius.

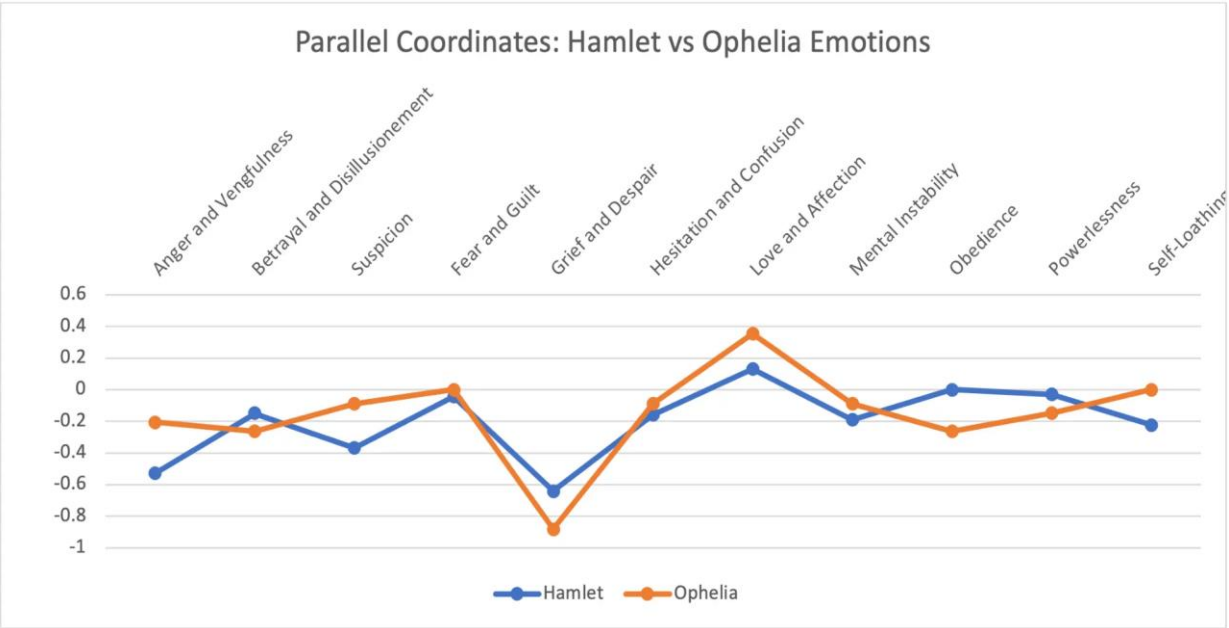

Figure 4: Parallel Coordinates - Hamlet vs Ophelia Emotions

This finding aligns with cognitive-emotional theory, which posits that emotions significantly influence decision-making processes. Hamlet's case illustrates how the conflict between doubt (which inhibits action) and anger (which impels action) creates a psychological mechanism that alternately paralyzes him and drives him to impulsive behavior. His tragic ending results directly from this emotional conflict—when his anger finally overcomes his doubt in the final scene, he acts decisively, but too late to avoid his destruction.

3.2. Ophelia's Primary Emotional Driver: Grief Amplified by Powerlessness

The parallel coordinates analysis (figure 4) confirms that Ophelia's primary emotional driver of her tragic demise is grief and despair intensified by powerlessness.

Grief and despair dominate Ophelia's emotional landscape, particularly following Hamlet's rejection and her father's death. Unlike Hamlet, whose grief is one of several competing emotions, Ophelia's grief becomes all-consuming, overwhelming her psychological resources. Her fragmented songs about death and lost love in Act 4 reveal the depth of this grief: "He is dead and gone, lady, and He is dead and gone; and At his head a grass-green turf, and At his heels a stone" (Act 4, Scene 5).

What makes this grief fatal, however, is its amplification by powerlessness. Ophelia's powerlessness manifests in her inability to determine her romantic fate, her exploitation as a political pawn by her father and Claudius, and her complete lack of agency following her father's death. Without the emotional resources or social power to process her grief constructively, Ophelia's despair becomes overwhelming.

The parallel coordinates analysis confirms that obedience also shows a distinctive pattern compared to Hamlet. This emotional configuration reflects her constrained social position as a noblewoman defined primarily by her relationships to men.

This finding aligns with feminist readings of Ophelia's character, which emphasize how patriarchal structures limit women's emotional expression and agency (Showalter, 1985). Our analysis provides empirical support for these readings by demonstrating the specific emotional mechanism—grief amplified by powerlessness—that drives Ophelia toward her tragic end. Her drowning represents the culmination of this emotional process, described in terms that blend intentionality with passivity: "her clothes spread wide, and And, mermaid-like, awhile they bore her up" (Act 4, Scene 7).

4. CONCLUSION

This study has employed computational and qualitative methods to identify the primary emotional drivers that propel Hamlet and Ophelia toward their tragic demises in Shakespeare's *Hamlet*. By analyzing sentiment trajectories, emotion co-occurrence networks, and parallel coordinates visualizations, we have isolated the specific psychological mechanisms that Shakespeare portrays with remarkable insight. The study's findings have several important implications for literary and emotional analysis. First, they demonstrate the value of focused computational approaches in identifying specific psychological mechanisms that drive character development and tragic outcomes. By isolating the primary emotional drivers for each character, we gain deeper insight into the psychological processes that Shakespeare portrays with such remarkable intuition.

Second, our analysis contributes to feminist and gender-focused interpretations of *Hamlet* by providing empirical support for claims about the gendered nature of emotional vulnerability in Shakespeare's work. The stark differences in emotional drivers between Hamlet and Ophelia highlight how social structures shape psychological experience and vulnerability, offering a data-driven perspective on gender dynamics in the play.

Third, this study enhances our understanding of Shakespeare's psychological insight by demonstrating the sophisticated emotional mechanisms he created in his characters. The doubt-anger nexus and grief amplified by powerlessness represent complex psychological processes that anticipate modern theories of emotional dynamics and mental health, suggesting that Shakespeare had an intuitive understanding of how specific emotional configurations can lead to self-destruction.

Fourth, our methodology offers a model for integrating computational and qualitative approaches in literary studies, showing how digital humanities techniques can complement rather than replace traditional interpretive methods. This integrated approach maintains sensitivity to literary and historical context while benefiting from the pattern-recognition capabilities of computational analysis.

Finally, this study contributes to broader discussions about the relationship between emotions and tragic outcomes in literature. By identifying the specific emotional drivers that propel characters toward their demises, we provide insight into how psychological mechanisms drive narrative development and character fate in tragic drama.

4.1. Directions for Future Research

This study opens several promising avenues for future research. First, similar methodologies could be applied to other Shakespearean tragedies to identify whether similar emotional drivers appear across different plays. Do other tragic protagonists exhibit the doubt-anger nexus that characterizes Hamlet, or do they operate under different psychological mechanisms? Such comparative analysis might reveal Shakespeare's consistent or evolving understanding of the relationship between specific emotions and tragic outcomes.

Second, future studies could extend this approach to include more characters from *Hamlet*, examining whether secondary characters exhibit distinct emotional drivers that contribute to the play's tragic development. Analysis of characters like Claudius, Gertrude, and Laertes would provide a more comprehensive picture of the emotional ecosystem of the play and how different psychological mechanisms interact to create tragic outcomes.

Third, researchers could explore how different editorial traditions and textual variants of *Hamlet* might affect the emotional drivers identified. The significant differences between the Folio and Quarto versions of the play could lead to different visualizations of emotional patterns, offering insight into how textual choices influence psychological portrayal.

Fourth, this methodology could be enhanced by incorporating historical emotion concepts more explicitly, perhaps by developing coding schemes based on early modern theories of humors and passions. Such a historically grounded analysis would provide a more authentic picture of how Shakespeare and his contemporaries understood emotional states and their consequences.

The enduring power of *Hamlet* lies partly in Shakespeare's profound understanding of human psychology and his ability to portray complex emotional mechanisms with remarkable precision and insight. Our analysis has attempted to identify the specific emotional drivers that Shakespeare wove into his characters, revealing how the tragic demises of Hamlet and Ophelia emerge from distinct but equally devastating psychological processes.

By isolating these emotional drivers, we gain not only a deeper appreciation of Shakespeare's psychological acuity but also insight into universal patterns of human emotional experience. The doubt-anger nexus that drives Hamlet and the grief amplified by powerlessness that destroys Ophelia reflect enduring truths about how specific emotional configurations shape our perceptions, decisions, and ultimately our fates. In this sense, computational analysis of emotional patterns in *Hamlet* does not demystify the play's power but rather illuminates the sophisticated psychological understanding that continues to make Shakespeare's work resonant and revelatory more than four centuries after its creation.

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AUTHORS' BIOS

***Abdelouahd BOUZAR** is a Doctor in the English language and literature, and a high school teacher. He specializes in Education, gender, statistics, gamification, textbook design, and AI.*

***Khaoula EL IDRISSI** is a doctor in the English language and literature, a dedicated High School English teacher. Her academic interests include gender and religion, media and culture, with a keen focus on artificial intelligence. She holds a Master's degree in Gender Studies and is dedicated to enriching societal discourse in her research and teaching..*